HAZARDOUS
SITE CONTROL
DIVISION

Remedial Planning/ Field Investigation Team (REM/FIT)

ZONE II

CONTRACT NO.
68-01-6692

CH2M HILL
Ecology & Environment

Executive Summary

Feasibility Study for Subsurface Cleanup

Western Processing
Kent, Washington

EPA 37.0L16.2

March 6, 1985

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PREFACE

This volume of the Western Processing Subsurface Cleanup Feasibility Study contains only the Executive Summary. Volume I contains Chapters 1 through 7, and Volume II contains Appendixes A through G.

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FIGURES

EXECUTIVE SUMMARY
OF THE
FEASIBILITY STUDY FOR SUBSURFACE CLEANUP
WESTERN PROCESSING
KENT, WASHINGTON

This Executive Summary presents the major findings of the Feasibility Study for Subsurface Cleanup, Western Processing, Kent, Washington (March 6, 1985). The Feasibility Study was prepared by U.S. Environmental Protection Agency (USEPA) and their contractor, CH2M HILL, under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (also known as the "Superfund" legislation).

The overall goal of the Feasibility Study is to provide relevant technical and other information about the Western Processing site and surrounding area in order for USEPA to select "...the lowest cost alternative that is technologically feasible and reliable and that effectively mitigates and minimizes damage to, and provides adequate protection of, public health, welfare or the environment" [40 CFR 300.68(j)].

To accomplish this goal, the following process was undertaken:

1. The nature and extent of contamination at the site was assessed using soil, sediment, surface water, and groundwater samples.

2. On the basis of the nature and extent assessment, an endangerment assessment was prepared that addressed the risks presented by the site to public health and the environment.

3. Example remedial action alternatives for mitigating the problems identified by the nature and extent and endangerment assessments were then developed.

4. The example remedial action alternatives were evaluated and compared to determine their relative cost, technical feasibility and effectiveness in remedying site problems, mitigating public health and environmental impacts, and complying with government standards and policies.

BACKGROUND

The Western Processing property is a 13-acre area located in the Green River Valley at 7215 South 196th Street, Kent, Washington. Figures S-1 and S-2 show the general location and site vicinity. The Western Processing Company, Inc., conducted industrial waste processing, reclamation, and

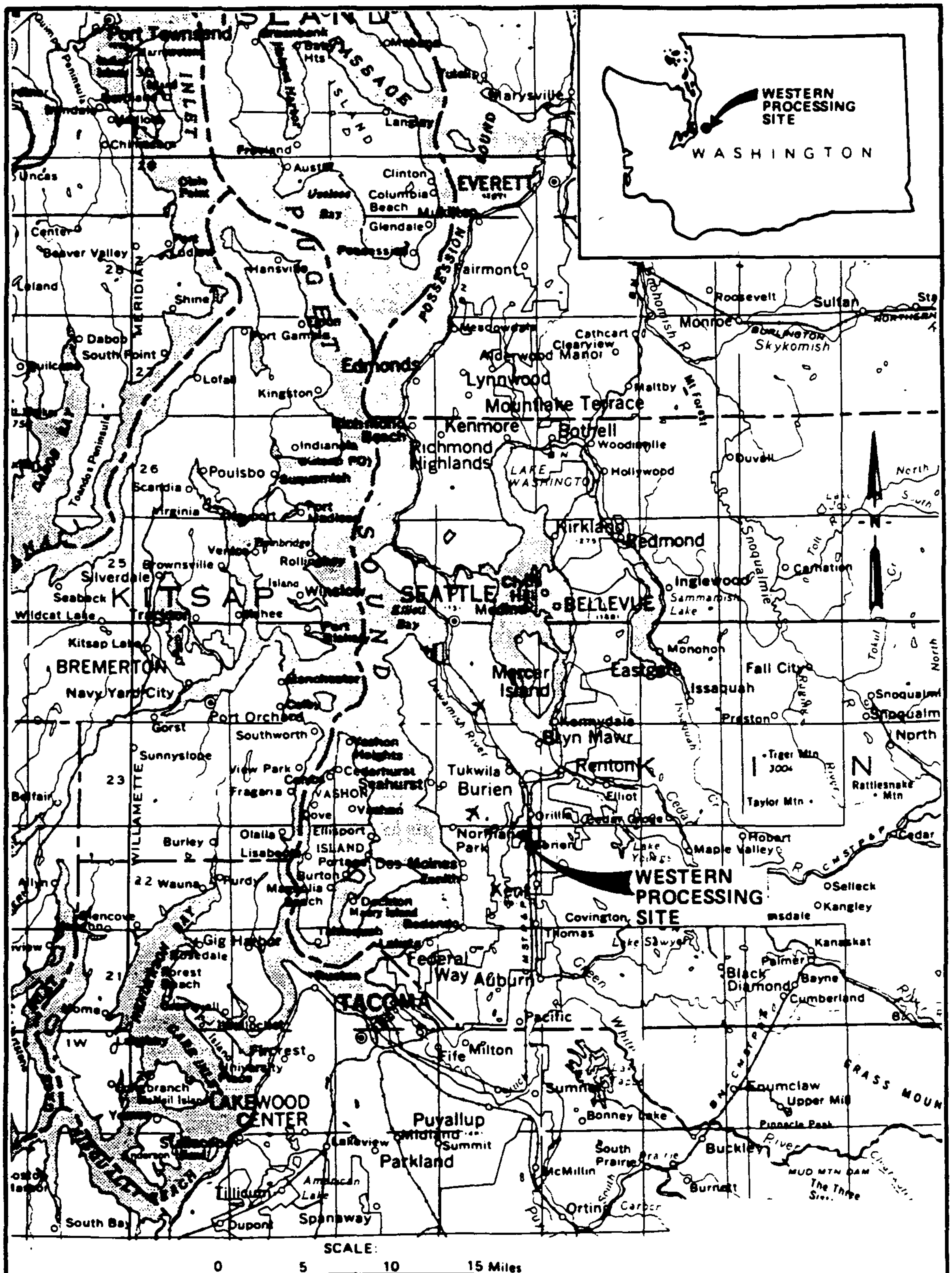

FIGURE S-1
LOCATION MAP

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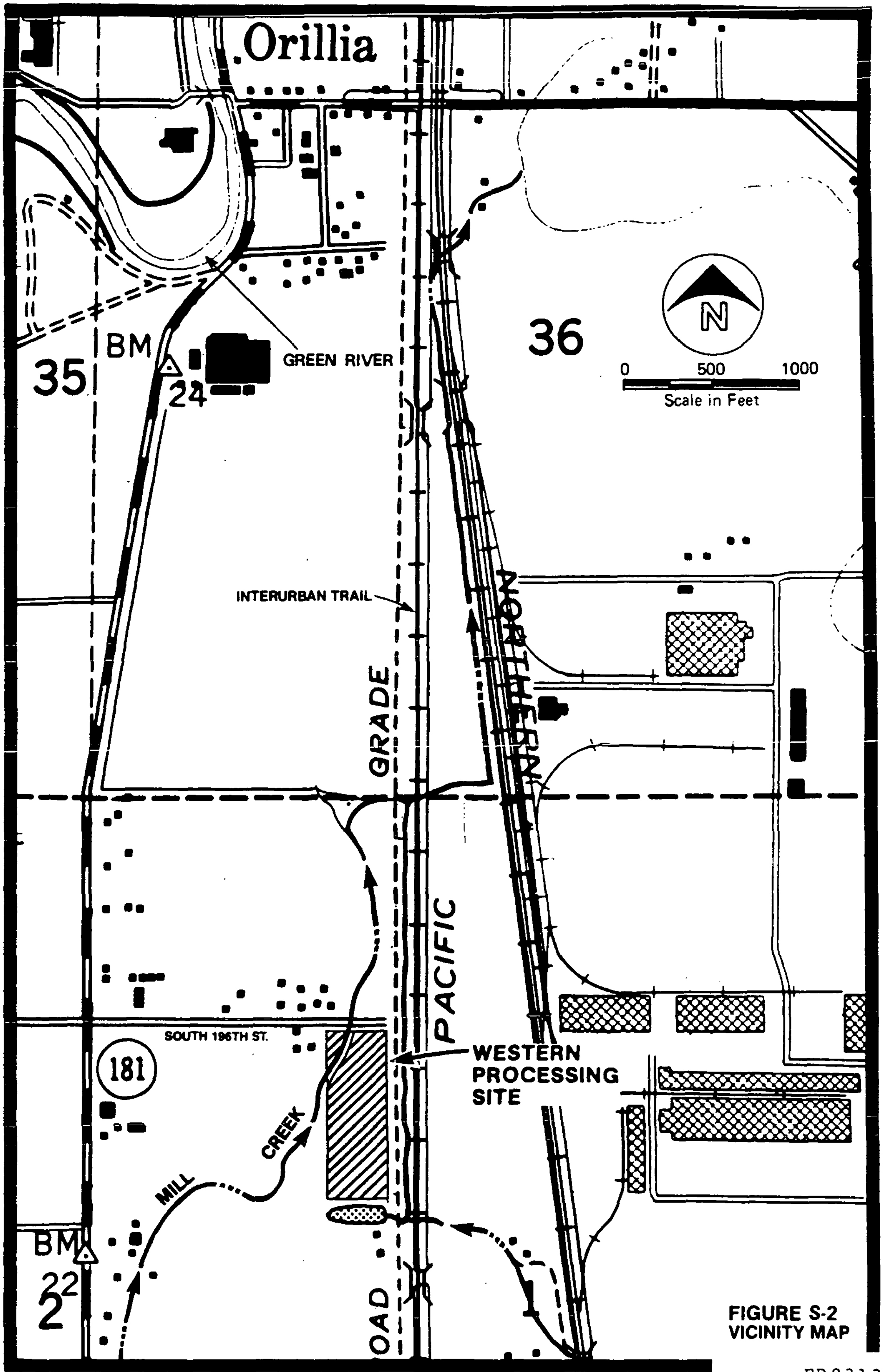
Orillia
36
35
BM
24
GREEN RIVER
0
500
1000
Scale in Feet
N
INTERURBAN TRAIL
GRADE
PACIFIC
OAD
NORTHERN
SOUTH 196TH ST.
181
WESTERN
PROCESSING
SITE
CREEK
MILL
BM
22
2
FIGURE S-2
VICINITY MAP

EB0313

storage activities on 11 of those acres between 1961 and 1983. These activities resulted in contamination of site soil and, subsequently, of groundwater and surface water on and near the Western Processing property.

Since the early 1970's, several agencies including the USEPA, Washington Department of Ecology (WDOE), Metro, and the Kent Fire Department have investigated problems at the site. Actual cleanup of the site began in 1983, when USEPA issued an administrative order pursuant to CERCLA instructing Western Processing to cease all operations at the site and to begin cleanup of the contaminated areas. Since then, there have been three major remedial activities undertaken to mitigate the hazards posed by the site.

First, in June 1983, a $1.4 million emergency removal action was undertaken by USEPA using CERCLA funds. Drums and impounded liquids that presented the greatest hazard were removed from the site. This removal action was completed in July 1983.

Second, from September through December 1983, WDOE undertook measures to control stormwater run-on and run-off at the site. These measures included: (1) removing the bottom material from a former surface impoundment (the reaction pond) and storing this material in a pile onsite; (2) covering the pile with an impermeable, flexible cover; (3) regrading and paving portions of the site to promote drainage; and (4) installing berms at the perimeter of the paved area to control run-on and run-off.

Third, in July 1984, Chemical Waste Management (CWM), Inc., under contract to the potentially responsible parties,[1] began a surface cleanup of the site costing about $9 million. The cleanup included: (1) removal of wastes and structures from the surface of the site; (2) grading and construction of a lined impoundment to provide stormwater collection; and (3) treatment of collected stormwater. The removal activities were completed in November 1984, with the exception of about 3,000 gallons of dioxin-contaminated liquid that had

[1] The potentially responsible parties are the individuals or companies that operated the Western Processing facility or who generated or transported the materials brought to the site. They are potentially responsible under CERCLA for funding or conducting the cleanup of the site. There are about 300 potentially responsible parties associated with Western Processing. In 1984 some of the generators and transporters formed a group called the Western Processing Coordinating Committee to negotiate the surface cleanup of the site with USEPA. In this executive summary, the term potentially responsible parties refers to this group.

to be placed in special temporary storage trailers located on the property until a long-term storage and/or disposal location could be identified. Treatment of the contaminated surface water will continue until the spring of 1985. Negotiations are underway with the potentially responsible parties to continue this activity until the next stage of cleanup begins. Figure S-3 shows the condition of the site in December 1984.

These remedial activities were primarily designed to alleviate the obvious and immediate environmental hazards and human health risks posed by the site. Further investigation of site contamination was undertaken as part of the feasibility study to provide data for better defining the existing and potential hazards posed by the site and for identifying final solutions to the problems.

NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at Western Processing was analyzed using soil, sediment, surface water, and groundwater samples collected on and off the Western Processing property between 1982 and 1984. The samples were tested to determine the presence of organic and inorganic contaminants, primarily the USEPA priority pollutants. Priority pollutants are chemicals that USEPA considers to be of particular concern when found in the environment above background levels. In all, approximately 90 of the 126 priority pollutants were found in Mill Creek or in the soil or groundwater on and off the Western Processing property.[1]

In order to simplify the analysis of the nature and extent of contaminantion at Western Processing, 16 indicator compounds were used to characterize the contamination on and off the Western Processing property. Table S-1 lists the indicator contaminants selected. They are the compounds that were frequently detected, are relatively mobile, or are highly persistent and toxic.

SOILS CONTAMINATION

In total, 81 of the USEPA priority pollutants (including all indicator compounds) were found in soils samples taken on the Western Processing property. Fifty-six of the priority pollutants were found in samples taken off the property. Some contaminants were found at low concentrations at depths to 80 feet, but most contamination occurred within 15 feet of the surface. Table S-2 and Figures S-4 through S-8 summarize the location of the indicator compounds within the

[1]The Western Processing property is not the source of contamination for all off-property contamination. Some areas across Mill Creek were contaminated by a separate source.

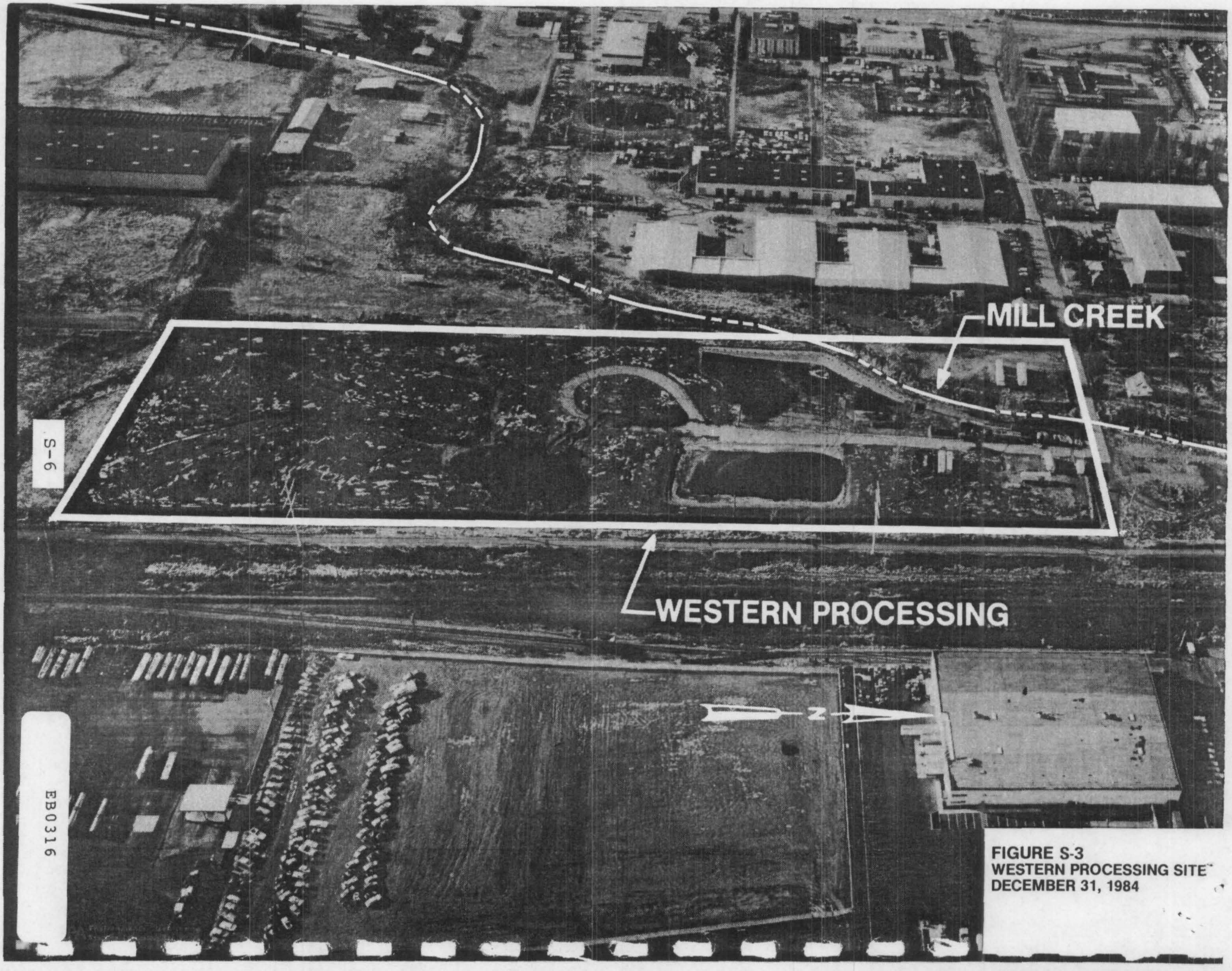

FIGURE S-3
WESTERN PROCESSING SITE
DECEMBER 31, 1984

EB0316

Table S-1
INDICATOR CONTAMINANTS USED AT WESTERN PROCESSING

Organics	Inorganics
Volatile Organics:	Metals:
1,1,1-Trichloroethane	Cadmium
Trans-1,2-Dichloroethene	Chromium
Tetrachloroethene	Copper
Trichloroethene	Nickel
Toluene	Lead
Chloroform	Zinc
Acid Extractable Compounds:	
2,4-Dimethylphenol	
Phenol	
Base/Neutral Compounds:	
Total PAH's[a]	
Total Phthalates	
Other Organics:	
PCB's	
Oxazolidone	

[a]Total priority pollutant polycyclic aromatic hydrocarbons (PAH's).

Table S-2
LOCATION OF CHEMICALS WITHIN THE SOIL PROFILE

Indicator Compounds	Depth Below the Surface Where Compounds Were Most Frequently Found	Depth Below the Surface Where Compounds Were Found in the Highest Concentrations
Metals	0 to 9 feet	0 to 9 feet
Volatile Organics	6 to 9 feet	6 to 9 feet
Acid Extractables	9 to 21 feet	9 to 21 feet
Base/Neutrals		
Total PAHs	0 to 3 feet	0 to 3 feet
Phthalates	0 to 9 feet	Surface soil
PCB's	Surface soil	10 feet (on-property) Surface soil (off-property)

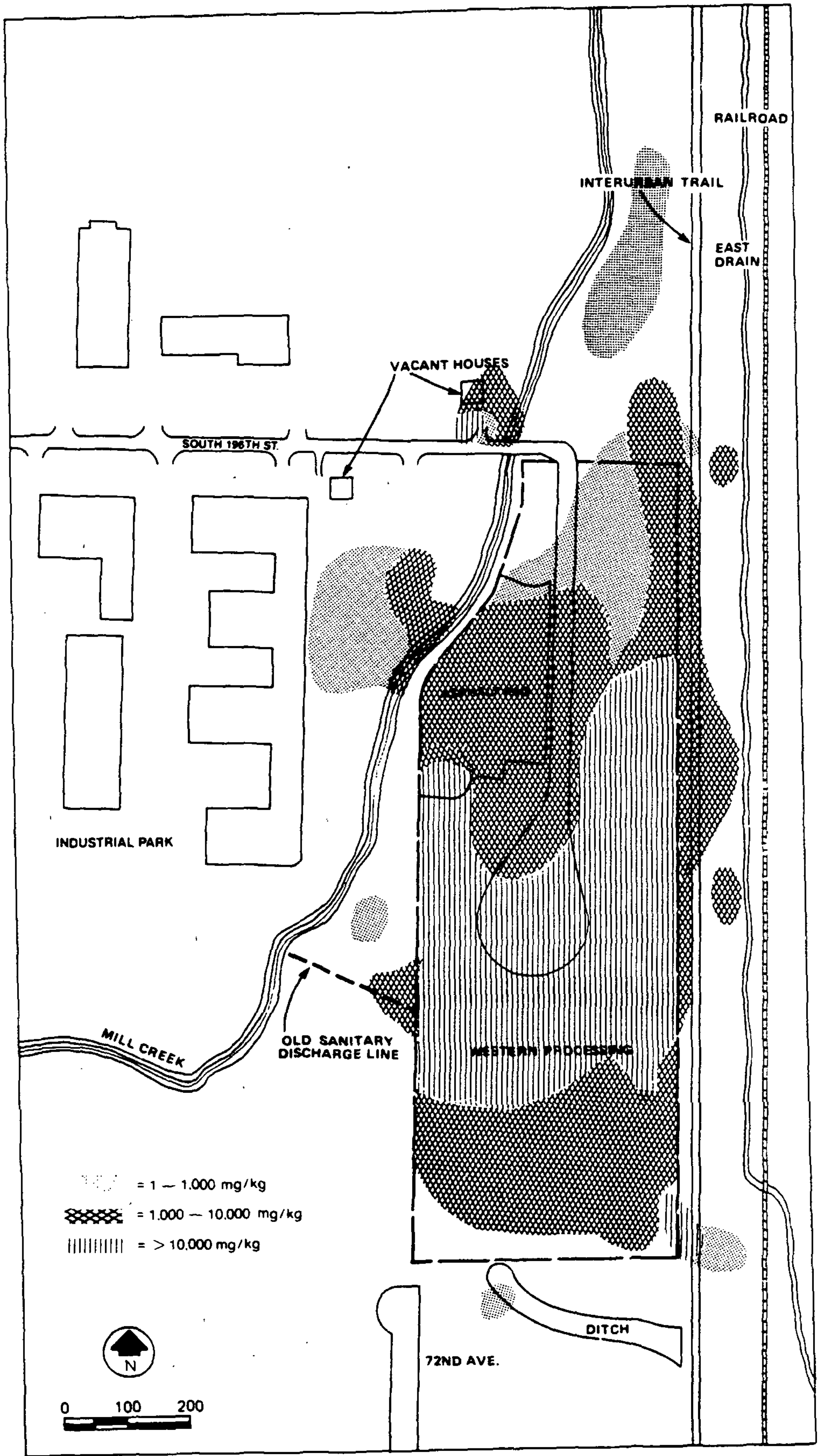

FIGURE S-4
SUMMARY OF NATURE AND EXTENT
INDICATOR METALS IN SOILS
0 TO 9 FEET BELOW GROUND SURFACE

EB0318

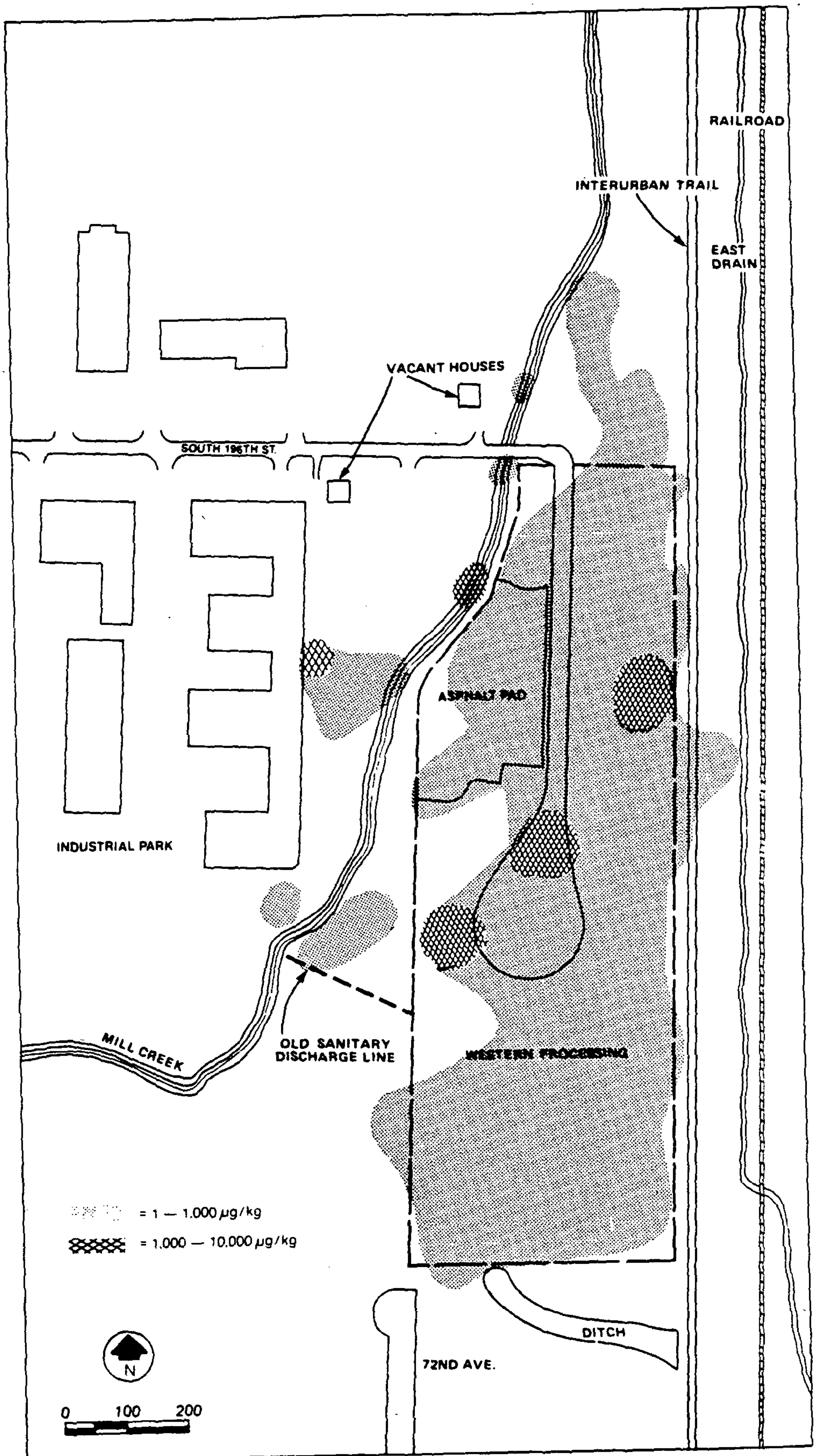

FIGURE S-5
SUMMARY OF NATURE AND EXTENT
INDICATOR VOLATILES IN SOILS 0 TO 9 FEET
BELOW GROUND SURFACE

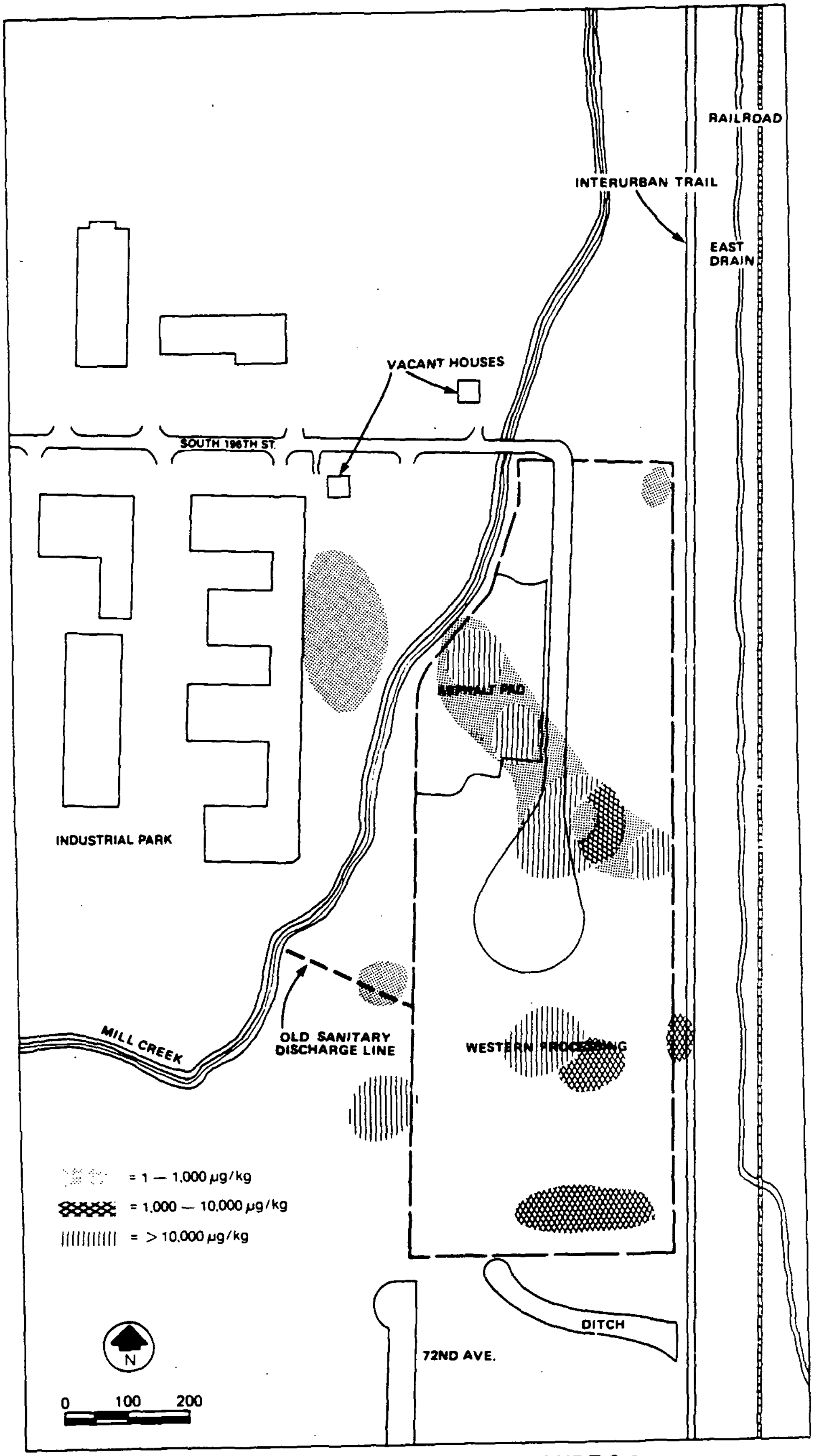

FIGURE S-6
SUMMARY OF NATURE AND EXTENT INDICATOR ACID EXTRACTABLES IN SOILS 0 TO 9 FEET BELOW GROUND SURFACE

EB0320

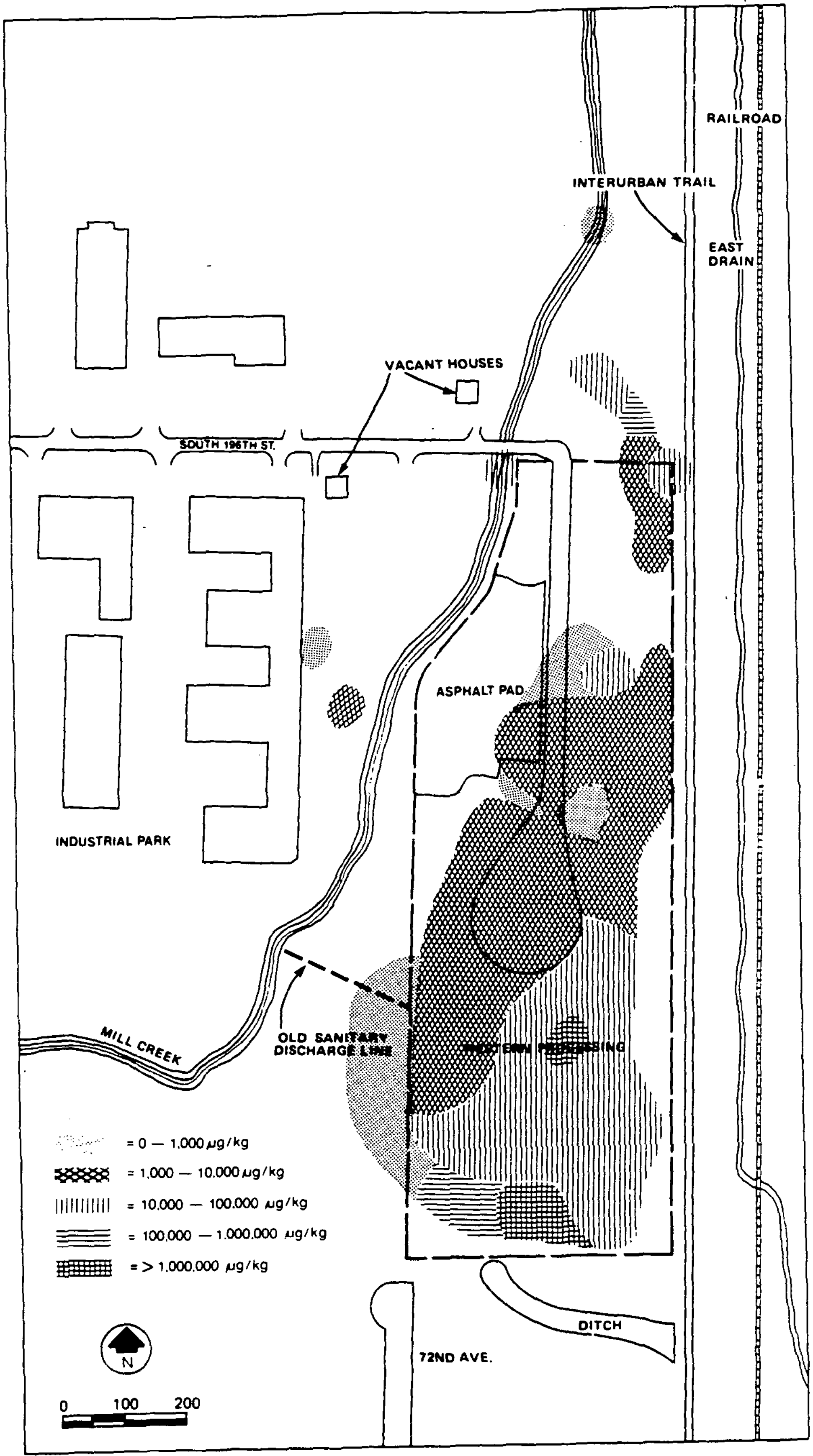

FIGURE S-7
SUMMARY OF NATURE AND EXTENT
TOTAL PAH COMPOUNDS IN SOILS
0 TO 9 FEET BELOW GROUND SURFACE

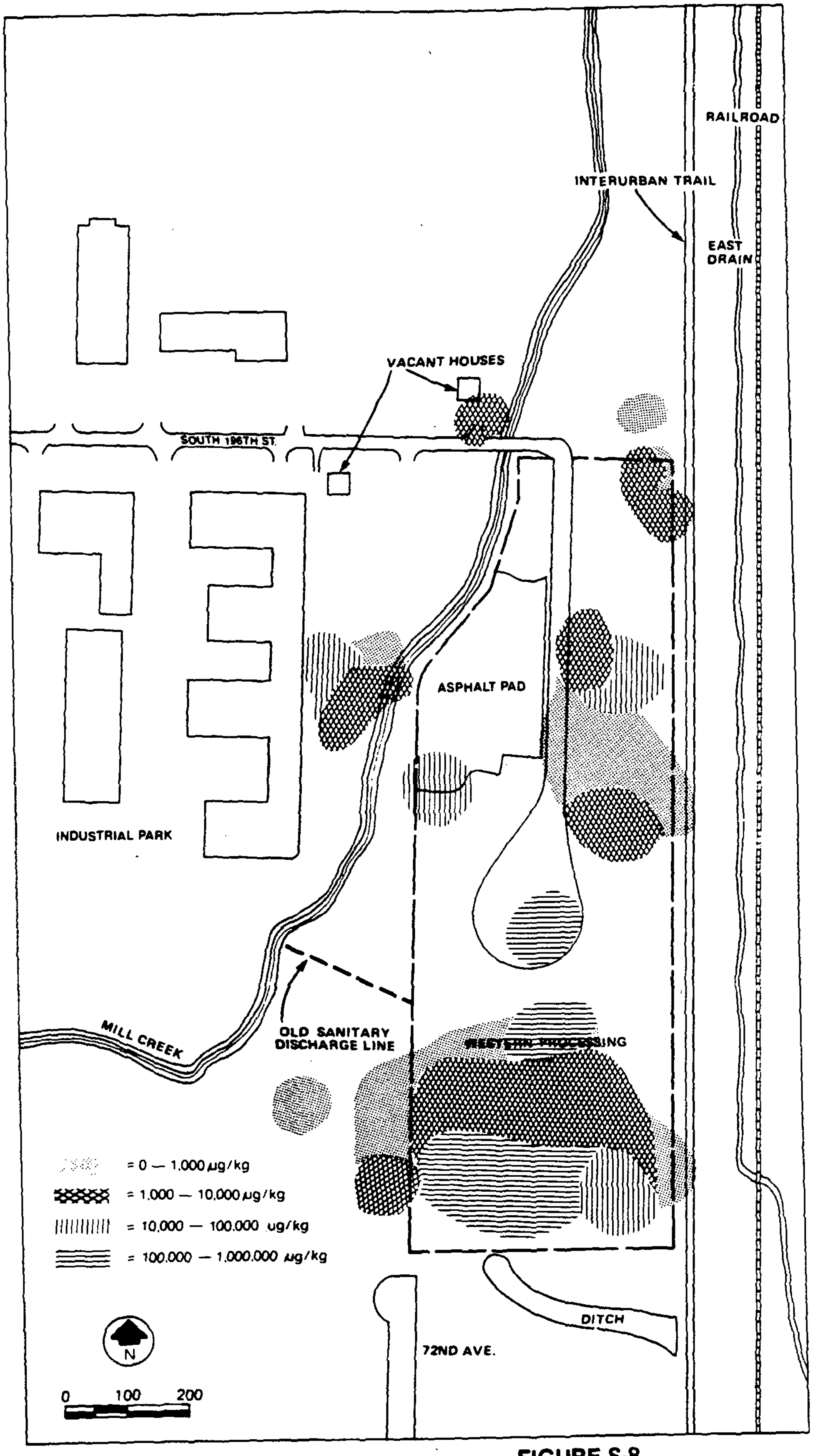

FIGURE S-8
SUMMARY OF NATURE AND EXTENT
TOTAL PHTHALATES IN SOILS 0 TO 9 FEET BELOW GROUND SURFACE

soil profile on and off the Western Processing property. The information contained in the table and figures is briefly described below.

Figure S-4 shows the concentrations of the indicator metals found in the soil down to 9 feet below the surface. The highest concentrations of the indicator metals were found in soils on the property. Lower levels (but still above background levels)[1] were found in off-property soil samples. Metal concentrations are greatest between the surface and 9 feet below. Priority pollutant metals concentrations above background do not appear to extend beyond about 20 feet below the ground surface.

Figure S-5 shows the extent of contamination from the volatile organic contaminants listed in Table S-1. They are most widespread in soil on the property at depths less than 9 feet. Within this depth range, they were found most frequently and in higher concentrations in soil from 6 to 9 feet below the surface.

Contamination by the acid extractable compounds is depicted in Figure S-5. Acid extractable contamination was found mostly in subsurface soil on the Western Processing property between 9 and 21 feet beneath the surface.

Base/neutral compounds as represented by total PAH's and total phthalates (Figures S-7 and S-8) were most frequently detected in soil on the property. PAH contamination was most widespread between 0 to 3 feet below the surface, with the highest concentrations also occurring between 0 and 3 feet. Phthalate contamination was most widespread between the surface and 9 feet. The highest concentrations of phthalates were found in surface soil.

PCB's were found onsite at depths up to 15 feet. Off the property, the majority of the PCB contamination was found in the surface soil. The maximum detected concentration was found onsite at 9 feet below the surface.

GROUNDWATER CONTAMINATION

Groundwater samples were taken from wells on and off the Western Processing property. The samples were tested for all USEPA priority pollutants. Fifty-six of the priority pollutants were identified in groundwater samples taken on

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[1]The determination of background concentrations is discussed in Chapter 2 of the Feasibility Study. For soil, indicator metals are assumed to have a total background concentration of 350 mg/kg. For groundwater, indicator metals are assumed to have a total background concentration of 525 μg/L.

the property and 53 in off-property wells. The greatest frequency of occurrence and the highest concentrations of all indicator compounds were found in shallow wells (0 to 15 feet).

Figures S-9 and S-10 show the locations and concentrations of the indicator compounds. Metals concentrations in groundwater were highest in shallow wells located on the northern end of the site. Total indicator metals in these wells often exceeded 100,000 mg/L. Total indicator metals concentrations in intermediate wells (16 to 57 feet deep) and in deep wells (60 to 135 feet deep) were highest in on-property wells and decreased off the property.

Volatile organic and acid extractable contaminant concentrations were highest in shallow wells on the property. Acid extractables were found in concentrations exceeding 10,000 mg/L in shallow wells only.

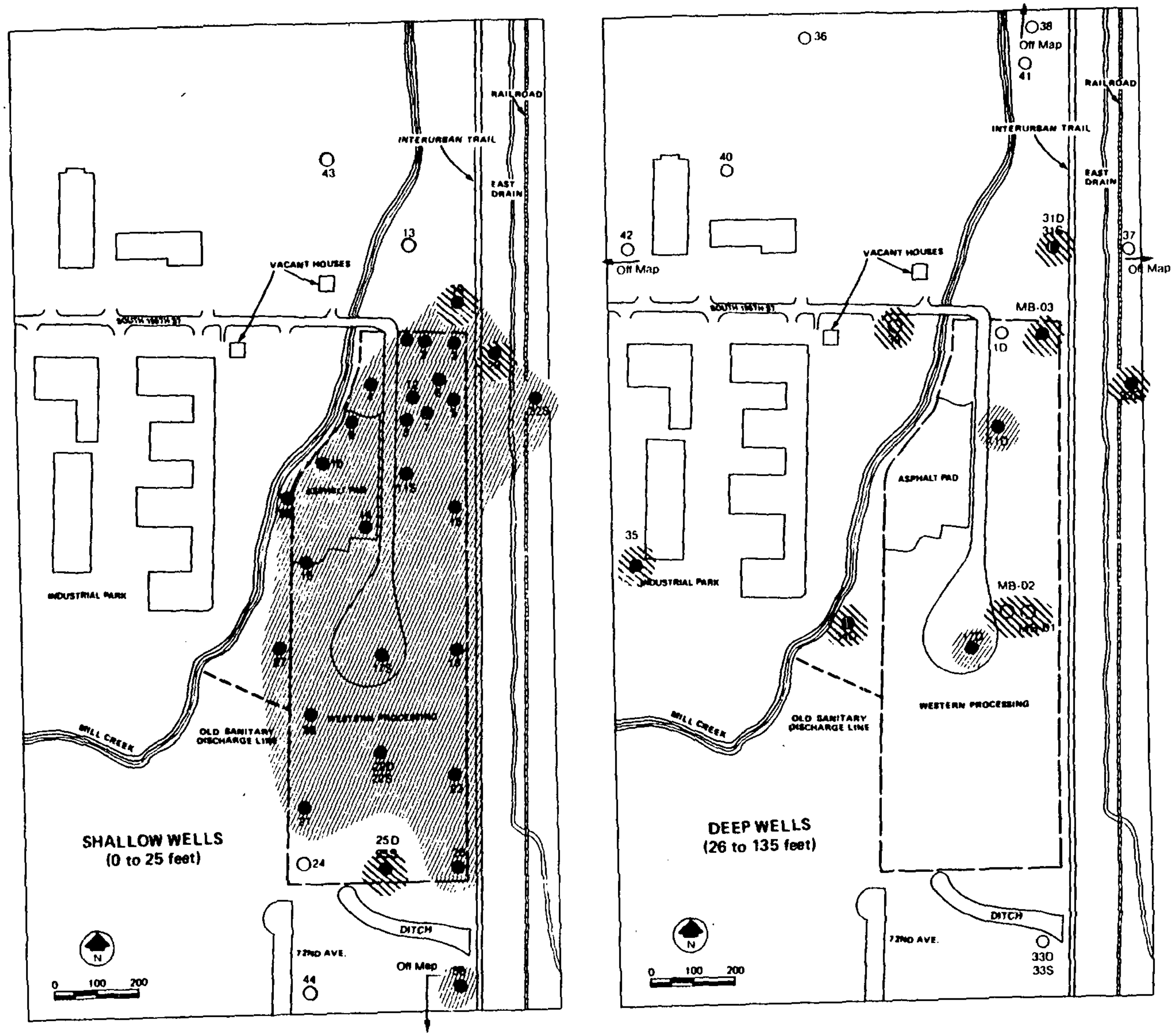
Base/neutrals, PAH's, and phthalates were detected infrequently in wells on or off the property. When they were detected, base/neutrals were found most frequently in on-property shallow wells in concentrations of less than 20 mg/L.

MILL CREEK CONTAMINATION

Contamination in Mill Creek consists primarily of high metals concentrations in the water and the channel sediments. Table S-3 shows the concentrations of the dissolved indicator metals in water samples taken from Mill Creek in 1984. The samples were taken upstream and downstream of Western Processing.

The data show that concentrations of several dissolved metals in downstream samples increased up to three orders of magnitude over the upstream samples. In Table S-3 the metals concentrations found in Mill Creek water samples are compared to the USEPA ambient water quality criteria for aquatic life. The concentrations of dissolved copper, lead, cadmium, nickel, and zinc exceeded the USEPA 24-hour ambient water quality criteria for aquatic life in most samples taken downstream of Western Processing. Concentrations of dissolved copper, cadmium, and zinc exceeded the USEPA maximum ambient water quality for aquatic life in one or more samples downstream of Western Processing.

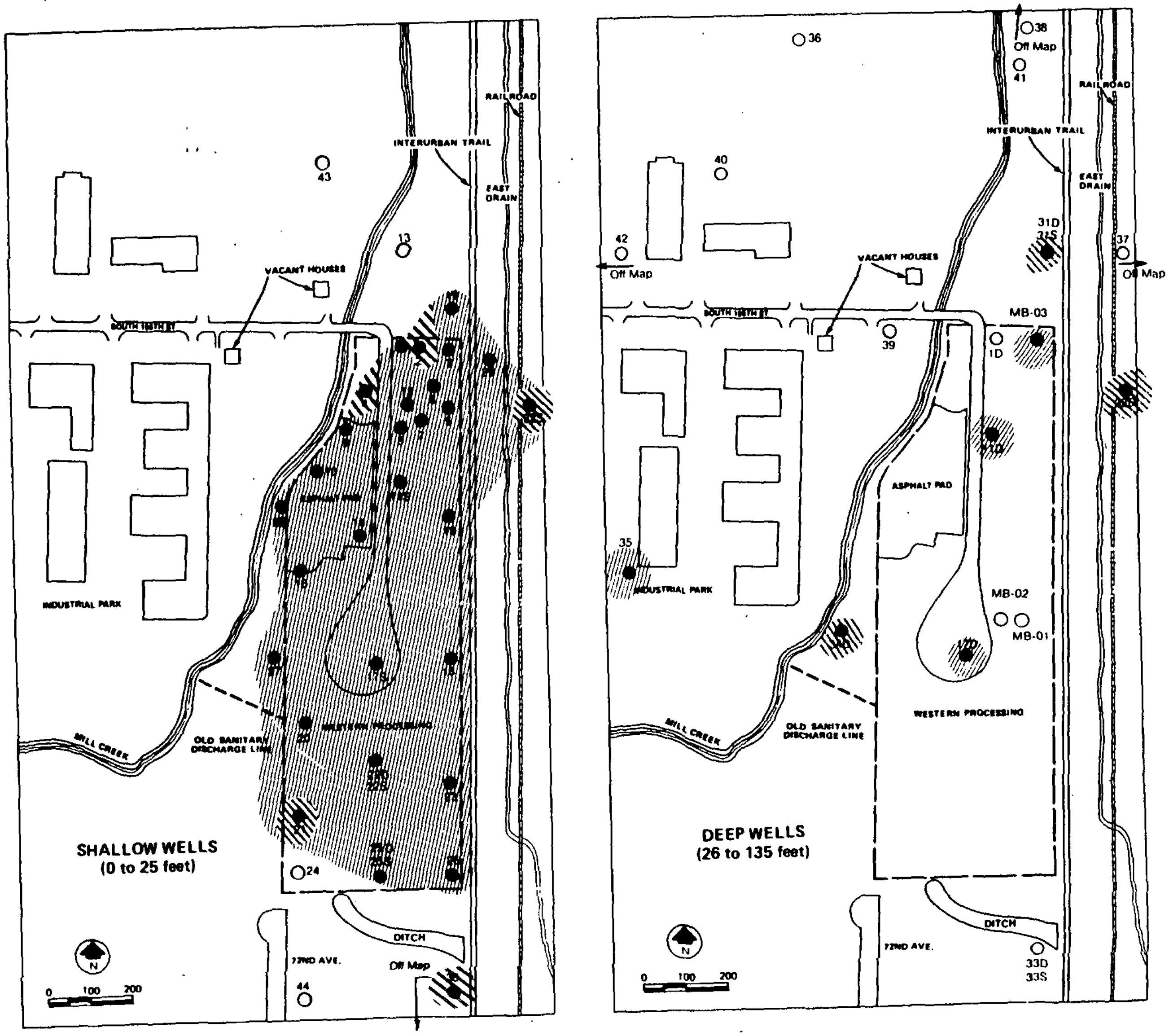
Twenty-five organic priority pollutants were found in Mill Creek water. However, most were found at levels below the USEPA ambient water quality criteria; organic contaminant concentrations appear to have diminished since surface remedial actions were taken.



//////// = Background to 1,000 μg/L
\\\\\\ = > 1,000 μg/L
27 = Well Number
○ = Well where indicator metals were detected at or below background levels.
● = Well where indicator metals were detected above background levels.

NOTE: Shaded area means that one or more indicator metals were measured at concentrations within the given range.

FIGURE S-9
SUMMARY OF NATURE AND EXTENT INDICATOR METALS IN GROUNDWATER



////////. = Quantified level to 1,000 μg/L

\\\\\\ = > 1,000 μg/L

27 = Well Number

○ = Well where indicator organics were not detected

● = Well where indicator organics were detected

NOTE: Shaded area means that one or more organic priority pollutants were detected at concentrations within the given range.

FIGURE S-10
SUMMARY OF NATURE AND EXTENT ORGANIC PRIORITY POLLUTANTS IN GROUNDWATER

Table S-3
CONCENTRATIONS OF DISSOLVED METALS IN MILL CREEK UPSTREAM AND DOWNSTREAM OF WESTERN PROCESSING

Dissolved Metals (μg/L)	Sampling Data[a] (μg/L)		EPA Ambient Water Quality Criteria[b] for Aquatic Life (μg/L)	
	Upstream	Downstream	24-Hour	Maximum
Chromium	n.d. to 2.0	n.d. to 5	29.0	21.0
Copper	n.d. to 2.0	12 to 23	5.6	18.0
Lead	n.d. to 2.0	n.d. to 8	2.3	131.0
Cadmium	n.d.	6.4 to 18.9	0.0354	4.3
Nickel	n.d.	45 to 104[c]	96.0	1,844.0
Zinc	n.d. to 41	113 to 936	47.0	425.0

Note: n.d. = not detectable.

[a]Samples were taken on four different days in 1984. The values shown in this table are the highest and the lowest sample values found. Samples taken on a fifth day (May 22, 1984) are not included in this table because flows in the creek were unusually high on that day and the sample data are therefore not expected to be representative of typical Mill Creek water quality.

[b]The criteria vary depending on the measured hardness of the water. The criteria shown are for the hardness measured in the upstream samples showing the highest concentration of the metals. This gives the least strict criteria.

[c]Hardness was not measured on the date that this sample was taken in order to calculate the ambient water quality criteria, a hardness value of 100 assumed.

Sediment samples from Mill Creek were also tested for metals and organics. Concentrations of some metals in Mill Creek sediments increased at Western Processing and remained high downstream of the site. Sediment concentrations of cadmium, chromium, copper, nickel, and zinc all increased ten- to one-hundred-fold at downstream locations relative to concentrations upstream of Western Processing. Other metals, such as lead, that are abundant in samples from the property did not increase in Mill Creek sediments downstream of Western Processing. It therefore appears that sediments in Mill Creek become contaminated by adsorbing metals from solution rather than from the deposition of contaminated soil via surface water runoff.

The results of sediment analyses for organic priority pollutants have been somewhat inconsistent. Contamination of Mill Creek sediments with organic compounds attributable to Western Processing is not clearly indicated from sediment analyses alone. The presence of phthalates, some PAH's, DDT derivatives, and low dissolved oxygen concentrations appear to be caused by sources upstream of Western Processing.

CONTAMINANT MIGRATION

The pattern of soil, groundwater, and Mill Creek contamination off the Western Processing property indicates that groundwater and surface water run-off have become contaminated following contact with contaminated soil and have then migrated from the property, thereby carrying contamination to other areas. The contribution of surface water to off-property contamination was reduced during 1983 and 1984 when remedial measures were taken by WDOE and CWM to control stormwater run-on and run-off. In the absence of remedial action, soil contaminants in the unsaturated zone will continue to leach into the already contaminated shallow groundwater.

Groundwater is the primary means by which contaminants are transported off the property. Most of the groundwater from beneath the Western Processing site flows toward and discharges into Mill Creek. Therefore, most of the contamination moving from the site via groundwater eventually discharges to Mill Creek.

ENDANGERMENT ASSESSMENT

The purpose of the endangerment assessment was to determine the present or potential risks presented by the site to public health and the environment. This was done by identifying the places where, or situations under which, people and the environment are or could be exposed to the contaminants and by quantifying the risks associated with this exposure.

The area immediately surrounding Western Processing is not heavily populated. Within 300 feet, the only occupied structures are roughly 160,000 square feet of single-story office, light industrial, and storage buildings. Drinking water for these businesses is supplied by the City of Kent. The shallow aquifer beneath the Western Processing site is not used for drinking or industrial water supply. The area is zoned for general and light industrial uses and is expected to be developed in the future in accordance with this zoning. Residential development would be limited to caretakers' residences permitted under the present industrial zoning.

RISK ASSESSMENT

The endangerment assessment addressed the human health risks that would result from ingestion (eating or drinking) of contaminated soil or water from the Western Processing property or Mill Creek. The main factors used in determining these risks are the concentrations of contaminants in the soil and water, the potential rate at which the contaminants might be ingested, and the potencies or toxicities of the contaminants.

RISK PRESENTED BY SOILS AND GROUNDWATER

Two methods were used to determine the public health risk presented by the contaminants at Western Processing. One method was used to address the risks associated with contaminants known or suspected to be carcinogens; the other method was used to address risks associated with toxic compounds.

For carcinogens, the risk was calculated using a mathematical model that estimates the increased probability of getting cancer for someone who ingests the soil or water from the Western Processing site over a long period. This is referred to as the excess lifetime cancer risk. Table S-4 shows the excess lifetime cancer risk expected to result from the ingestion of contaminated soil or groundwater from the Western Processing site.

The concentrations of contaminants in the soil and groundwater are high enough that regular ingestion would increase the cancer risk for those who ingest them. In general, Table S-4 presents an over-estimate of the human health risk posed by the soil and water because the rates assume continuing ingestion over a period of at least 40 years. The rate of soil ingestion leading to the maximum cancer risk assumes that people live near and ingest the soil from the property for 70 years. Because residential development in the area is not expected, this scenario is unlikely. Both the maximum and minimum cancer risks presented by the groundwater are over-estimated because both risk calculations are based on regular consumption of the groundwater. However, the shallow groundwater beneath Western Processing is not used as a drinking water source. Other types of exposure would result in a lower excess lifetime cancer risk.

For non-carcinogens, USEPA has identified the daily contaminant intake levels that, if exceeded, can cause observable health effects in humans. This level is referred to as the acceptable daily intake (ADI). The ADI's are used to evaluate the hazard posed by non-carcinogenic contaminants found at Western Processing. Table S-5 shows the compounds for which the ADI levels would be exceeded, given the mean concentrations of contaminants found at Western Processing and an assumed consumption of 0.1 gram of soil per day or 2 liters of groundwater per day.

Table S-4
EXCESS LIFETIME CANCER RISK RESULTING FROM INGESTION OF CONTAMINATED SOIL OR GROUNDWATER AT WESTERN PROCESSING

	Maximum Risk	Minimum Risk
Risk resulting from ingestion of the soil on the Western Processing property (0.1 gram per day over a 40-year period)	8 people in 1,000 who ingest the soil at the indicated rate	2 people in 10,000,000 who ingest the soil at the indicated rate
Risk resulting from ingestion of groundwater under the Western Processing site (2 liters per day over a 70-year period)[a]	5 people in 10 who ingest the groundwater at the indicated rate	3 people in 1,000 who ingest the groundwater at the indicated rate

[a]No one is using this water as a drinking water source.

Note: This table shows the number of people who would get cancer if they ingested soil or groundwater from the Western Processing site at the indicated rate. The risk level varies depending on the concentrations of contaminants assumed to be present in the soil or water and the amount ingested.

Table S-5
CONTAMINANTS AT WESTERN PROCESSING OCCURRING IN CONCENTRATIONS THAT COULD RESULT IN EXCEEDANCE OF ADI'S

Soil	Groundwater
Lead	Toluene
Chromium	1,1,1-Trichloroethane
Cadmium	Bis(2-ethylhexyl)phthalate
	Phenol
	Cadmium
	Chromium
	Cyanide
	Lead
	Mercury

Note: Daily intake of the above contaminants would exceed the ADI's as calculated using the concentrations of these contaminants measured in the soil and groundwater on the property and an assumed ingestion rate of 0.1 gram soil/day or 2 liters water/day.

RISK PRESENTED BY MILL CREEK

The risk presented by Mill Creek to human health was evaluated based on the measured levels of carcinogens and dissolved metals in the creek water and an assumed ingestion rate. Given an ingestion rate of 2 liters of water per day, none of the ADI's for metals would be exceeded by drinking Mill Creek water. The risk presented by carcinogens in Mill Creek was estimated assuming a lifetime use of the water as drinking water. It was estimated that one person in 10,000 who used Mill Creek as a lifetime drinking water source would get cancer because of the ingestion of carcinogens. Because Mill Creek is not used as a drinking water source, the risk is hypothetical in these scenarios. A more probable future use of Mill Creek is recreational use. Exposure resulting from recreational use of Mill Creek would not lead to health risks.

Concentrations of dissolved metals in Mill Creek exceed the water quality criteria for protection of aquatic life. Table S-3 shows the contaminant concentrations found in Mill Creek and compares them with the criteria for protection of aquatic life. It is reasonably certain that some aquatic species found in Mill Creek could not remain near Western Processing without being adversely affected by the metals contamination. Concentrations of organic priority pollutants in Mill Creek are generally not high enough to adversely affect aquatic organisms.

DESCRIPTION OF EXAMPLE REMEDIAL ACTION ALTERNATIVES

Given the nature and extent of contamination on and off the property and the environmental and human health risks that the contamination poses, a comprehensive list of possible remedial action technologies that could be used to remedy the contamination was developed. The technologies were identified from a literature review and knowledge of remedial actions undertaken at other uncontrolled hazardous waste sites. An initial screening was conducted to identify the technologies that are proven and most applicable to the problems at Western Processing. The technologies that were selected through the screening process are listed in Table S-6.

The types of problems existing at Western Processing were then categorized as follows:

- Potential direct human and animal contact with contaminants from Western Processing

- Past and potential future contaminated surface water runoff

Table S-6
TECHNOLOGIES AVAILABLE FOR USE IN EXAMPLE REMEDIAL ACTION ALTERNATIVES

A. Surface Caps

- Sprayed asphalt
- Portland cement concrete
- Bituminous concrete (asphalt)
- Gravel over geotextile over clay
- Loam over synthetic membrane over sand
- Loam over clay
- Loam over sand over synthetic membrane over clay (RCRA cap)

B. Groundwater Containment or Diversion Barriers

- Soil-bentonite slurry wall
- Cement-bentonite slurry wall
- Grout curtain

C. Groundwater Pumping

- Well points
- Deep wells

D. Soil Excavation

E. Sediment Removal

- Mechanical dredging

F. Groundwater Treatment

- Aerobic treatment systems
- Neutralization
- Precipitation
- Cyanide oxidation
- Organic chemical oxidation
- Reduction
- Organic chemical dechlorination
- Molecular chlorine removal
- Flow equalization
- Activated carbon
- Ion exchange
- Membrane processes
- Liquid/liquid extraction
- Filtration
- Air stripping
- Steam stripping
- Offsite treatment at a commercial facility

G. Groundwater Disposal

- Discharge to a publicly owned treatment works (Metro)
- Discharge to Mill Creek
- Discharge to the Green River
- Shallow reinjection

H. Soil Disposal

- Offsite landfill
- Onsite landfill
- Offsite incineration

I. Mill Creek Diversion

- Piped gravity bypass
- Ditches and trenches (new channel)
- Pump and pipe system with diversion dam

- Infiltration and subsequent leaching of contaminants from the unsaturated zone into the groundwater.[1]

- Contaminated groundwater quality beneath the Western Processing site.

- Contamination of Mill Creek via groundwater migrating from the site to levels that exceed background or ambient water quality criteria levels.

The list of suitable technologies was then used to develop a set of remedial action components that were determined to be particularly suitable for these problems. The remedial action components and the problems they address are shown in Table S-7.

Table S-7
REMEDIAL ACTION COMPONENTS

Component	Problem Addressed
Surface cap	Direct contact with contaminants, infiltration, contaminated runoff
Excavation (and disposal)	Contaminant leaching from unsaturated zone, direct contact with contaminants, contaminated runoff, source materials below the groundwater table
Groundwater extraction, treatment, and disposal	Groundwater contamination, contaminant discharge to Mill Creek
Diversion barrier	Contaminant discharge to Mill Creek
Mill Creek sediment removal	Direct contact of aquatic organisms with chemicals adhering to or released from contaminated sediments

[1]The unsaturated zone is that subsurface area between the land surface and the top of the groundwater table.

In addition, a sixth component, monitoring, was identified as necessary to evaluate the effectiveness of any remedial action undertaken to mitigate problems at the Western Processing site.

As can be seen, none of the remedial action components is capable by itself of addressing all the problems at Western Processing. Therefore, to provide a comprehensive remedial action, some or all of the components must be combined.

As an example of the comprehensive actions that might be appropriate at Western Processing, four example remedial action alternatives were identified for evaluation as part of the Feasibility Study by combining different remedial action components. A remedial action plan developed and evaluated by the potentially responsible parties was included as part of the Feasibility Study as an additional example alternative. The PRP plan was developed to meet a different set of goals that included returning the site to productive, unrestricted use (see Appendix A to this study). CERCL (Superfund) allows expenditures only to protect public health and the environment. "No action" alternatives for the on- and off-property areas and for Mill Creek were also identified for a total of seven example alternatives.

The purpose of developing these example alternatives was to show a range of actions that could be taken at the site from "no action" (leaving the site as it is) to one that removes most of these contaminants. Not all possible remedial action alternatives were identified. No one example alternative is recommended over another, and the remedial action technologies can be recombined to create other acceptable example alternatives. Any alternative selected as the final remedial action would be further refined during final design. The seven example alternatives are described below. Table S-8 summarizes the remedial action components included in each of the example alternatives.

EXAMPLE ALTERNATIVE 1: NO ACTION

A no-action example alternative was evaluated because it provides a baseline for comparison with the other alternatives. This alternative consists of leaving the property as it is and taking no further action to control or remove contaminants from on or off the property. Under this alternative, the site problems described under the nature and extent of contamination and the endangerment assessment would remain.

Table S-8
SUMMARY OF COMPONENTS INCLUDED IN EXAMPLE ALTERNATIVES

	Remedial Action Components[a]				
Example Alternative	Excavation/ Disposal	Groundwater Extraction/Treatment	Diversion Barrier	Surface Cap	Mill Creek Sediment Removal
1	None	None	None	None	None[b]
2	None	Well point system on and off-property	None	On and off property	None[b]
3	108,000 cubic yards of on- and off-property soil; disposal in on-property double-lined, RCRA landfill.	Well point system around landfill perimeter; on-property treatment plant	None	On and off property	None[b]
4	75,000 cubic yards of on-property soil; disposal in off-site double-lined, RCRA landfill.	Well point system on property; on- or off-property treatment plant	Around property perimeter	On property	See Example Alternative 7
5	300,000 cubic yards of on- and off-property soil disposal in offsite double-lined, RCRA landfill	Well point system around perimeter of property and excavation; on-property treatment plant	None	None	None[b]
6	None	None	None	None	None
7	None	None	None	None	1,700 cu yd

[a]All example alternatives also include monitoring to evaluate effectiveness of the actions.

[b]It is assumed that Example Alternatives 6 and 7 would be combined with Example Alternative 1, 2, 3, or 5 to provide a complete remedial action.

EXAMPLE ALTERNATIVE 2: SURFACE CAP AND GROUNDWATER PUMPING AND TREATMENT

Figure S-11 shows a plan view of the components of this example alternative. It includes a cap over the property and portions of off-property Area V, and a groundwater extraction (pumping) system and treatment plant. Example Alternative 2 would take approximately one year to construct. The groundwater pumping and treatment system would operate for at least 30 years.

The surface cap would be approximately 5 feet thick and consist of the following layers: topsoil (24 inches thick), geotextile filter, sand (12 inches thick), impermeable synthetic membrane, and compacted clay (24 inches thick). The groundwater extraction system consists of 9 pumps withdrawing groundwater from 340 well points located under the cap and in an area to the north of the property. The pumped groundwater would be collected and treated at a treatment plant located in the northwest corner of the property. The treatment system would consist of a four-step process involving the following:

- Air stripping to remove volatile organics
- Lime precipitation to remove heavy metals and organics
- Oxidation of organics using hydrogen peroxide
- Granular activated carbon adsorption to remove additional organics

Following treatment, the groundwater would be discharged into a Metro sanitary sewer.

EXAMPLE ALTERNATIVE 3: EXCAVATION WITH ONSITE DISPOSAL, SURFACE CAP, GROUNDWATER PUMPING AND TREATMENT

Figure S-12 shows a plan view of the components of this example alternative. It includes excavation of on-property soil within the unsaturated zone (an average of 6 feet deep), disposal of the excavated soil in an onsite landfill, construction of a cap over the landfill and areas to the east and west of the property, and a groundwater pumping and treatment system. Example Alternative 3 would require approximately 4 years to construct with the groundwater pumping and treatment system operating for at least 30 years.

A total of about 108,000 cubic yards of soil would be excavated. The landfill would have to be constructed in stages, and soils excavated during each stage would have to be temporarily stockpiled on the property before they could be

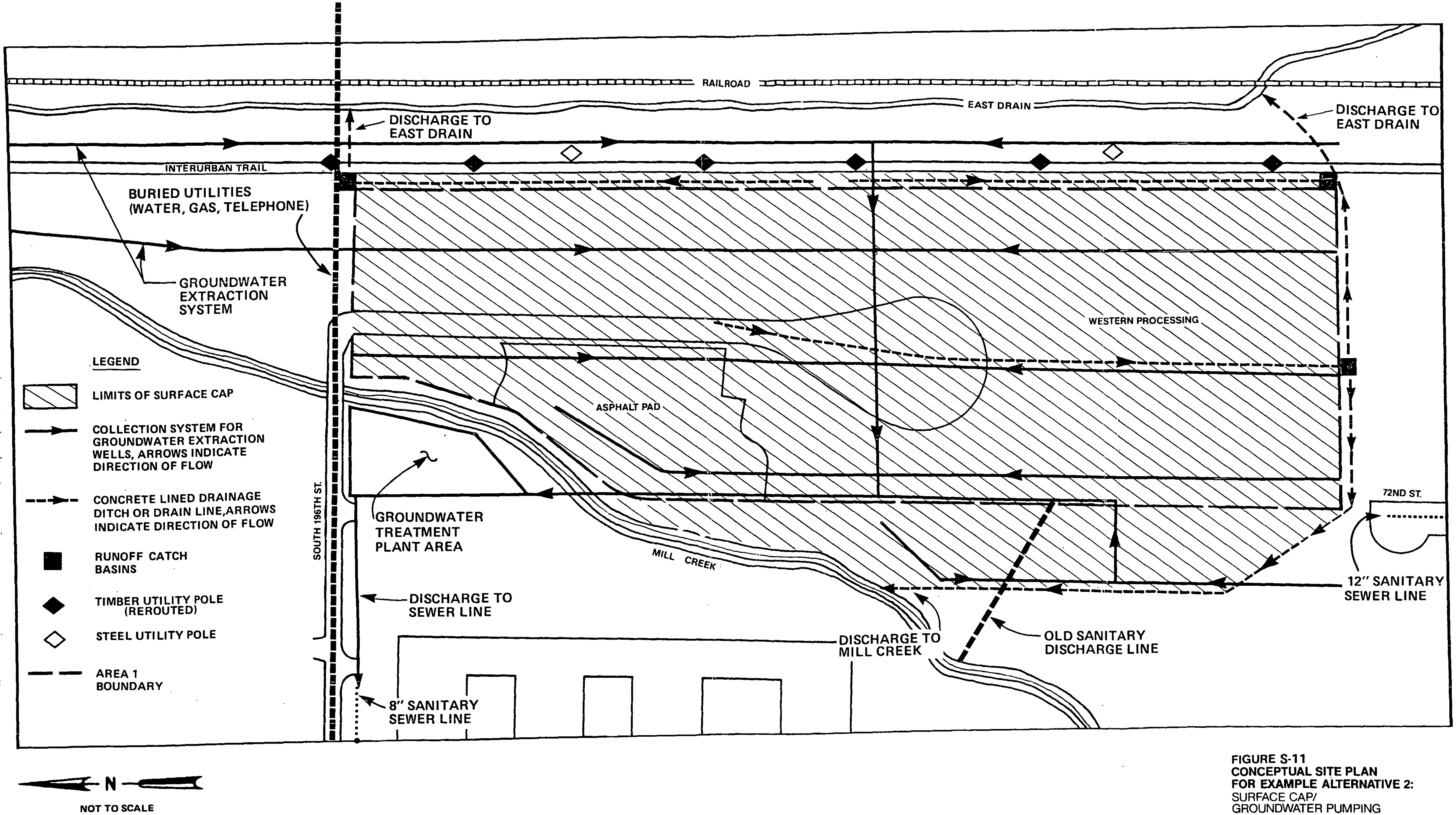


FIGURE S-11
CONCEPTUAL SITE PLAN FOR EXAMPLE ALTERNATIVE 2:
SURFACE CAP/ GROUNDWATER PUMPING AND TREATMENT

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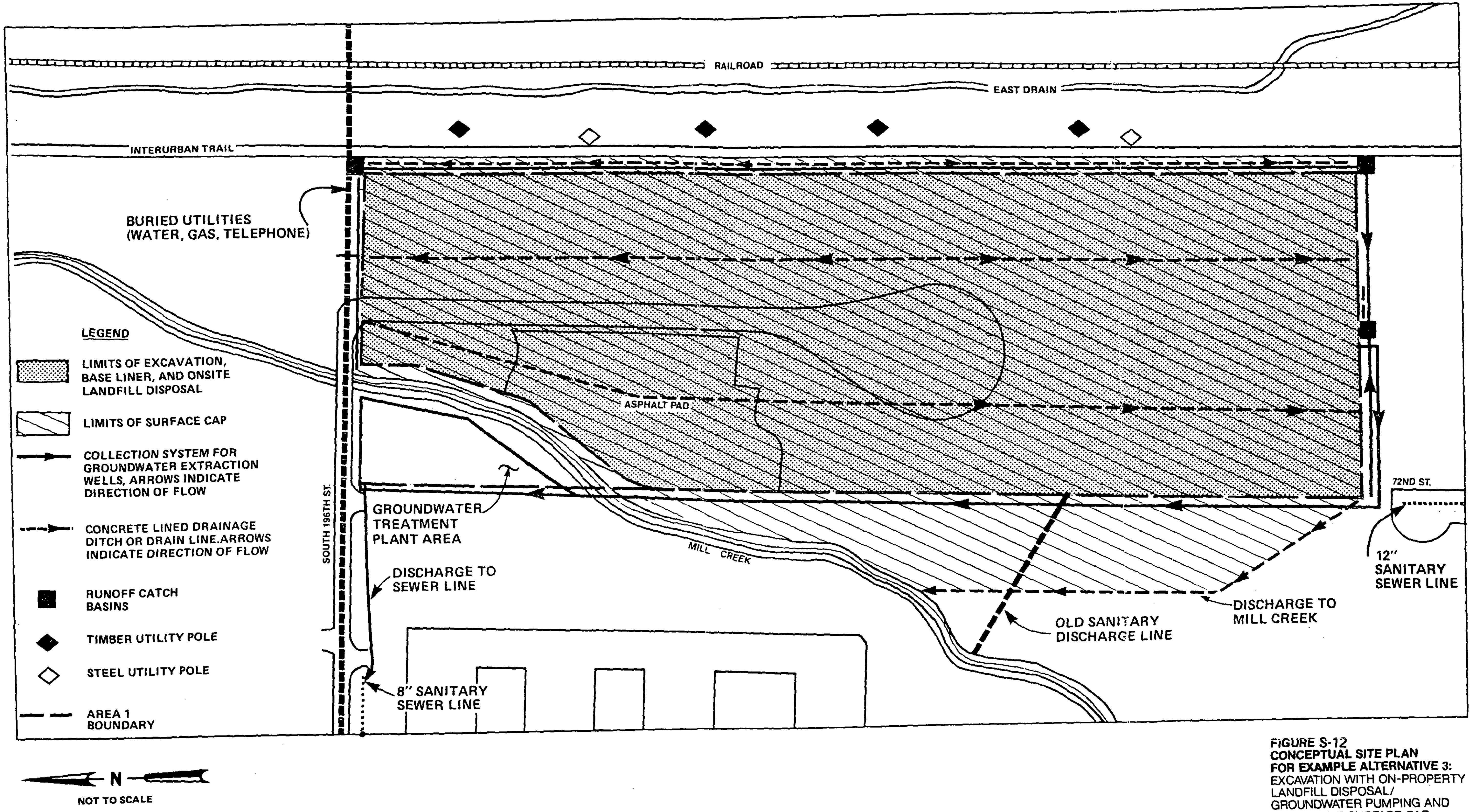

FIGURE S-12
CONCEPTUAL SITE PLAN
FOR EXAMPLE ALTERNATIVE 3:
EXCAVATION WITH ON-PROPERTY LANDFILL DISPOSAL/ GROUNDWATER PUMPING AND TREATMENT/SURFACE CAP

placed in the landfill. The landfill would have a bottom liner and a cap so that the contaminated soil would be completely isolated within the landfill. The cap would consist of layers similar to the layers described for the cap in Example Alternative 2. The liner system would consist of the following components, starting from the bottom: a 24-inch clay liner overlain by a synthetic membrane, a 12-inch sand layer containing a leak detection and removal system, a primary synthetic membrane liner, a 12-inch sand layer containing a leachate collection and removal system, and a geotextile fabric filter.

The groundwater pumping and treatment system would be similar to the system proposed for Example Alternative 2, except that fewer well points would be used and would be located around the perimeter of the landfill.

EXAMPLE ALTERNATIVE 4: POTENTIALLY RESPONSIBLE PARTIES' REMEDIAL ACTION PLAN[1]

Figure S-13 shows a plan view of Example Alternative 4. It consists of six main components: a multi-depth excavation, groundwater pumping and treatment, a subsurface diversion barrier, a surface water infiltration system, an asphalt/concrete cap, and removal of sediment from Mill Creek. The remedial action proposed for Mill Creek is the same as in Example Alternative 7. It would take approximately 8 years to complete Example Alternative 4.

The purpose of the excavation program is to remove the most highly contaminated soil. A total of about 75,000 cubic yards of contaminated soil would be excavated to depths ranging from one to 8 feet below the surface of the property. Excavated soils would be disposed of offsite in a USEPA-permitted, double-lined RCRA hazardous waste landfill. The excavated areas would be filled with imported soil.

The surface water infiltration system, which would operate during the groundwater pumping period, would allow precipitation to percolate into the unexcavated soil in the unsaturated zone. As it moves toward the groundwater, this infiltrating precipitation would pick up contaminants and carry them into the groundwater. These contaminants would then be removed along with other contaminants in the groundwater by the pumping system. The groundwater pumping and treatment system would be similar to the system in Example Alternative 2 and would operate for a period of up to five years.

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[1]This alternative was developed, described, and evaluated by the potentially responsible parties.

A diversion barrier would be installed around the property to a depth of 40 feet. The barrier would have two purposes. During operation of the pumping system, the barrier would prevent groundwater around the property from being drawn directly into the well points. It would instead allow the pumping system to draw groundwater from the deeper portions of the aquifer up through the contaminated soil in the upper portion of the aquifer. As this water is drawn upward through the soil, it would flush contaminants from the soil and allow them to be removed by the pumping system.

After the pumping system is removed, the diversion barrier would slow the rate of any potential residual contaminant migration from the property by 50 percent, thereby reducing the concentration of contaminants potentially migrating from the property. This effect is important for the protection of Mill Creek.

After the groundwater pumping system is dismantled, an asphaltic concrete pavement would be laid over the site.

EXAMPLE ALTERNATIVE 5: EXCAVATION WITH OFFSITE DISPOSAL, DEWATERING, GROUNDWATER TREATMENT

Figure S-14 shows a plan view of Example Alternative 5. It consists of soil excavation, groundwater pumping to dewater the excavation, and subsequent groundwater treatment. The excavation program would last four years. Soil excavation would occur during five months of each year. The dewatering system would operate throughout the four-year period.

About 300,000 cubic yards of contaminated soil would be removed. The soil on the property would be excavated to a depth of 15 feet below the land surface which is 9 feet below the water table. Excavation off the property would range to depths of from one to 3 feet. All excavated soils would be disposed of at a USEPA-permitted, double-lined, RCRA hazardous waste landfill, and the excavated areas would be filled with imported soil.

Because the lower 9 feet of the 15-foot excavation would be below the water table, groundwater would have to be prevented from accumulating in the excavations. This water would be removed by a well point system installed around the perimeter of the property with localized dewatering of the excavation and treatment in an onsite treatment plant. The treatment system would be similar to that used in Example Alternative 2.

EXAMPLE ALTERNATIVE 6: MILL CREEK NO ACTION

Under this example alternative, no remedial action would be taken within Mill Creek. However, the main source of water

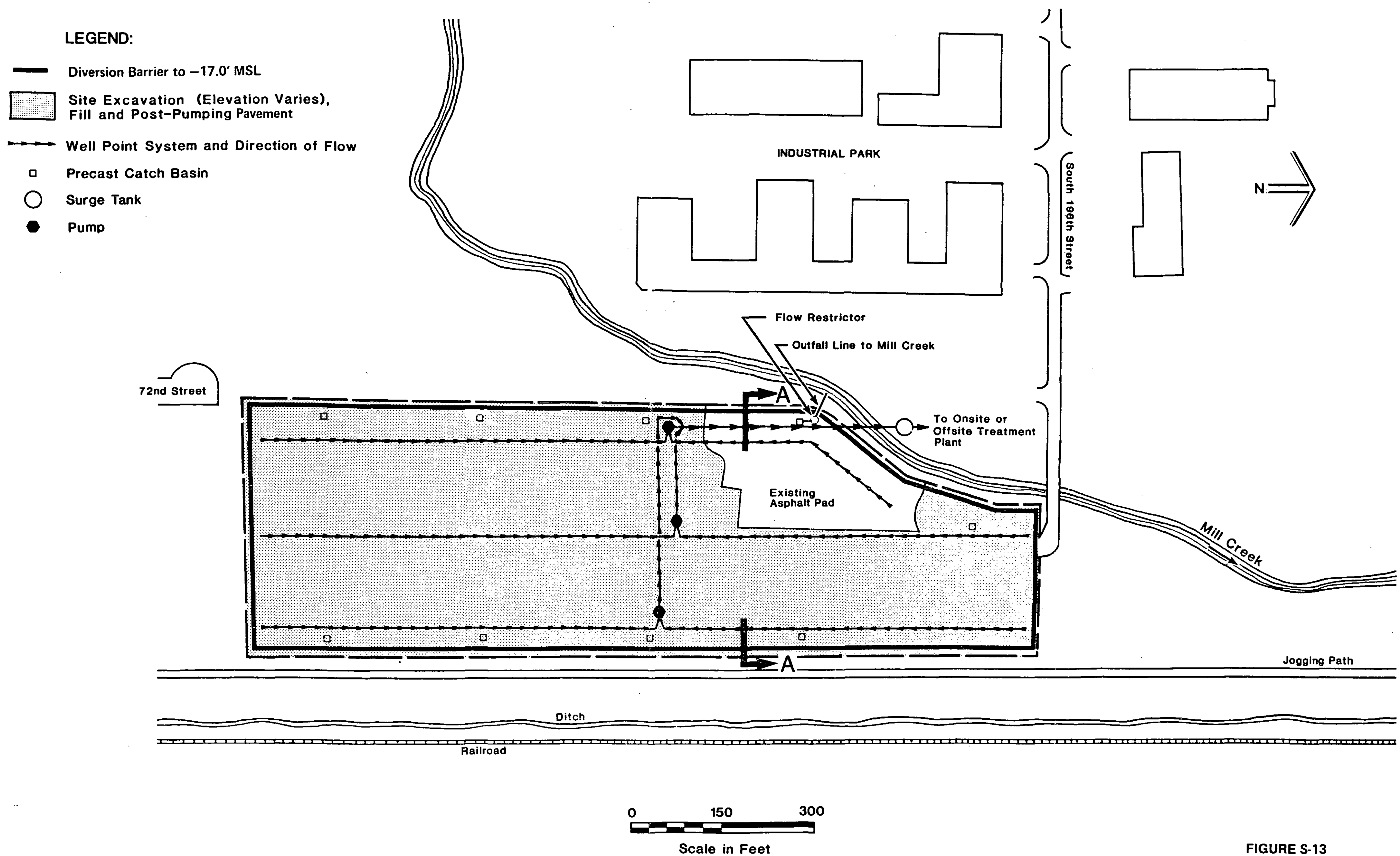

FIGURE S-13
SITE PLAN FOR
EXAMPLE ALTERNATIVE 4
WESTERN PROCESSING
Kent, Washington

EB0341

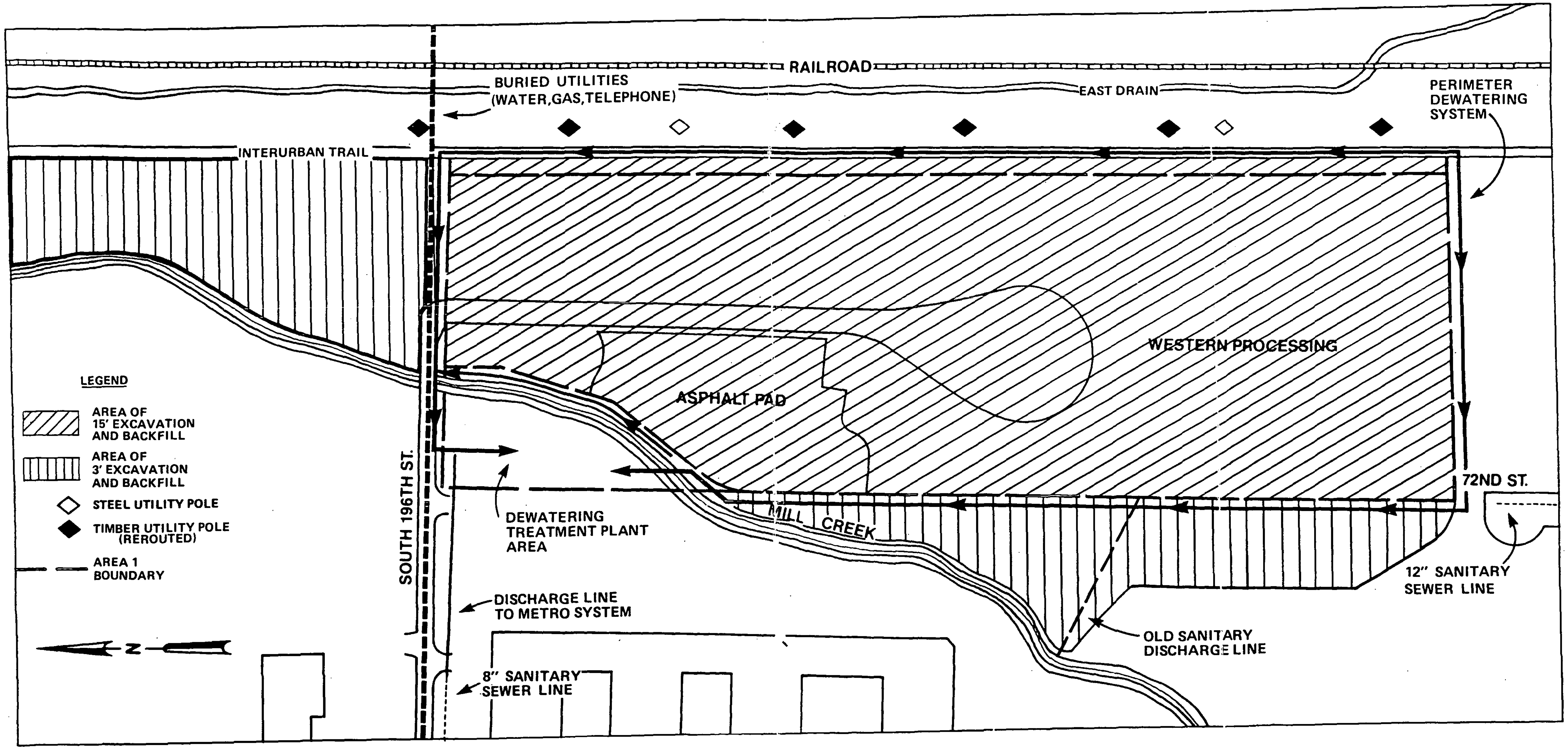

FIGURE S-14
CONCEPTUAL SITE PLAN
FOR EXAMPLE ALTERNATIVE 5:
EXCAVATION ABOVE AND BELOW
GROUNDWATER TABLE WITH
OFF-SITE DISPOSAL

EB0342

quality degradation in Mill Creek is the contaminated groundwater discharging to the creek from Western Processing. Therefore, measures such as those proposed in Example Alternatives 2, 3, 4, and 5 that control or reduce the source of contaminant leaching to the groundwater and improve groundwater quality would substantially reduce contamination in Mill Creek. After an effective source control action, however, contaminated sediments would remain in the creek and continue to release contaminants into the creek water. Contaminated sediment would be present for approximately 5 to 10 years after contaminated groundwater stops discharging to the creek.

ALTERNATIVE 7: MILL CREEK SEDIMENT REMOVAL

This example alternative involves removing the top 12 inches of sediments from a segment of Mill Creek approximately 2,300 feet long. In all, approximately 1,700 cubic yards of material would be removed. Construction of this alternative would require the temporary diversion of Mill Creek. Figure S-15 shows the location of the diversion pipeline and diversion structures (dams). The stream segment between the point of diversion and the discharge location would be dewatered and dredged. Costs are based on excavated materials being disposed of in a USEPA-permitted, double-lined, RCRA hazardous waste landfill. The channel would be rebuilt with gravel riffles to allow natural processes to return it to preexcavation conditions. The stream banks would be replanted with native vegetation.

ALTERNATIVES EVALUATION

Each of the seven alternatives described above was evaluated for the following:

- Technical feasibility and effectiveness
- Consistency with governmental laws, regulations, and policies
- Impacts on the environment and human health
- Costs of construction and operation

Table S-9 summarizes the results of this evaluation of the example alternatives. The areas used in this table to describe and evaluate the scope of each example alternative are identified on Figure S-16. The example alternatives presented in this report (except the no action alternatives) are effective in reducing risks to public health and the environment. A major difference is the length of time necessary to achieve the remedy. A 30-year period has been used as a reference time for comparing the relative effectiveness of the example alternatives. Performance beyond 30 years is discussed for those alternatives that have not achieved criteria by that time.

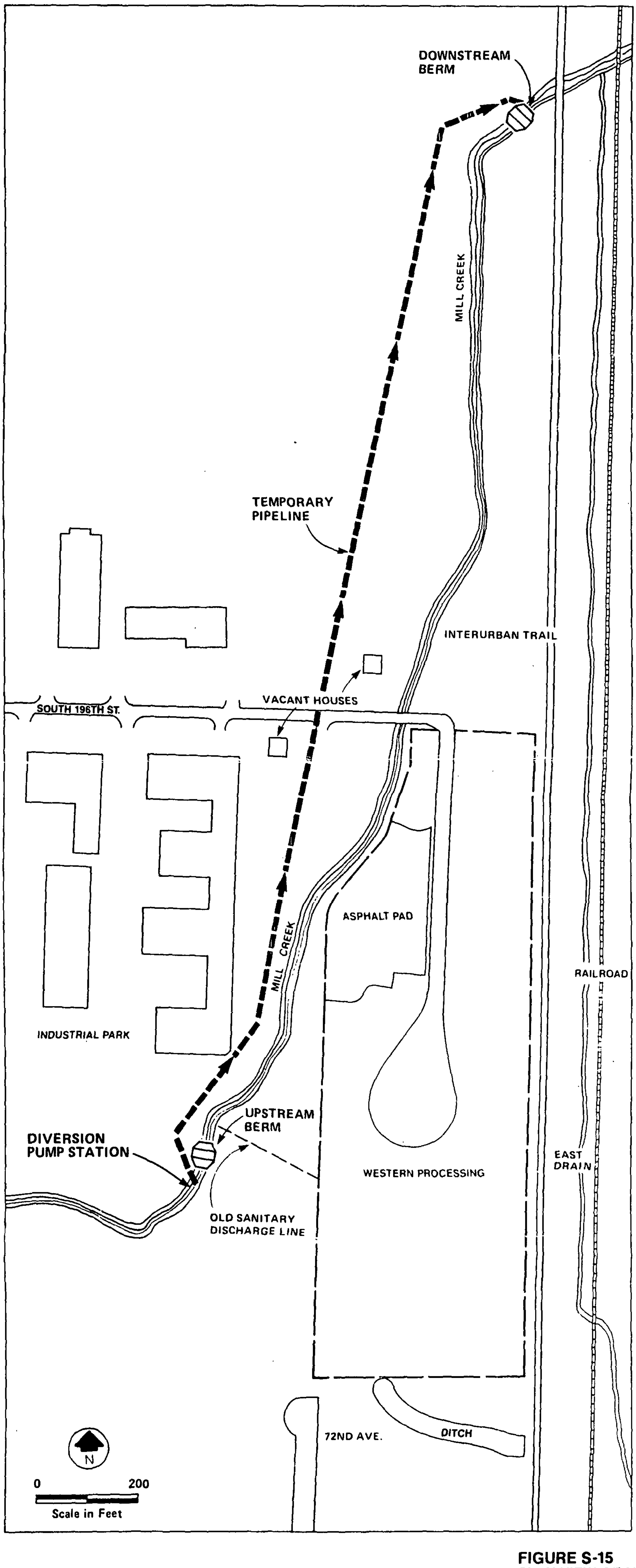

FIGURE S-15
PLAN VIEW OF MILL CREEK DIVERSION BERMS AND TEMPORARY PIPELINE

Table S-9
SUMMARY OF PUBLIC HEALTH, ENVIRONMENTAL, AND TECHNICAL EVALUATIONS

Example Alternative	Cost (Millions) Capital	Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
1. No Action	-0-	-0-	On-property contamination (soils up to 12 feet deep) would continue to have potential maximum lifetime excess cancer risk (worker scenario) of 5×10^{-4}. Groundwater contamination from Western Processing would pose no threat to City of Kent or any other public water supply wellfields. The concentrations of organic and inorganic (metal) contaminants in the groundwater immediately below Western Processing exceed drinking water standards and Acceptable Daily Intake (ADI) levels. Ingestion of this groundwater over a 40-year period could lead to a maximum lifetime excess cancer risk (worker scenario) of 2×10^{-1}. However, the shallow aquifer is not used for water supply. Recreational use of Mill Creek would not pose a threat to human health.	Priority pollutant metal concentrations in Mill Creek downstream of Western Processing exceed chronic and acute ambient water quality criteria for aquatic organisms. These metal concentrations probably are and would continue to be toxic to a wide variety of aquatic organisms for hundreds of years. Priority pollutant organic concentrations in Mill Creek downstream of Western Processing do not exceed ambient water quality criteria for aquatic organisms. Sediments in Mill Creek contain high levels of priority pollutant metals.	Stormwater runoff would be in contact with contaminated soils and could carry contamination from the site onto adjacent areas and into Mill Creek. Infiltration would continue to leach contaminants from the unsaturated zone and carry them into the groundwater beneath the site. Contaminated groundwater from Western Processing would continue to discharge into Mill Creek at 50 to 70 gpm. Groundwater quality beneath the site would improve only very slowly (i.e., would require well beyond hundreds of years to achieve levels that would not adversely impact Mill Creek water quality).	Since 1983, three major response/remedial actions at Western Processing have stopped the discharge of contaminated runoff from the property to Mill Creek and removed waste materials and all structures from the surface of the property. These actions have eliminated potential hazards such as fires, explosions, and spills or leaks of waste materials. Future use of the site may be restricted by local authorities.
2. Multimedia cap over Areas I and II, and a portion of Area V (provides two layers to prevent infiltration). Controlled stormwater discharge from capped areas into Mill Creek Groundwater pumping from Areas I, II, V and IX, onsite treatment and	$12.2 Average annual operation & maintenance cost/ $1.87	$30.2	Would eliminate direct human and animal contact with contaminated surface soils in capped areas; however, all soils would remain in place. Drinking water standards and ADI's for organics in the groundwater under the site would be met in less than 15 years of pumping; SNARL's* for longer term use would not be met until after approxi-	Once pumping begins, Mill Creek waters would approach ambient water quality criteria or background (whichever is higher) for dissolved metal contaminants. Contaminants adhering to Mill Creek sediments and gradually leaching back into Mill Creek waters may delay achieving ambient water quality criteria or background. Would eliminate contaminated	The pumping system would eliminate discharge of contaminated groundwater to Mill Creek from Areas I, II, V, and IX during the pumping period. An extremely long pumping, treatment, and systems maintenance period would be required before water quality criteria, standards, or background levels could be met in	Would comply with RCRA technical requirements for closure as an existing land disposal facility. The groundwater extraction rate would be limited primarily by sewer system capacity and secondarily by the permeability of the soils.

NOTE: See Figure S-16 for locations of Areas I through X.

*Suggested No Adverse Response Level(s).

EB0346

Table S-9
(continued)

	Example Alternative	Cost (Millions) Capital	Cost (Millions) Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
2.	Continued discharge into Metro system (100 gpm) Monitoring Health and safety plans and training prior to construction			mately 40 years of pumping. Achieving federal drinking water standards in the groundwater for metal contaminants would be much more difficult. For example, it would require well beyond 100 years of pumping to achieve the cadmium standard, while the standard for lead may never be achieved.	stormwater discharges from capped area. Approximately 60 to 120 years of groundwater pumping would be required to reduce the concentrations of metals in the groundwater to levels that would not cause continued degradation of Mill Creek after the pumping system is turned off. Water quality problems in Mill Creek upstream of Western Processing, such as low dissolved oxygen levels, could continue to limit the habitat quality in Mill Creek.	Mill Creek after the pumping system is turned off. Cap would prevent infiltration and leaching of contaminants from the unsaturated zone in Areas I, II, and V into the groundwater. Effective cap lifetime in this application is not known. Would require permanent access to some adjacent properties. Would require a 12-month construction period. Cap would require relatively complex construction techniques. Construction impacts could be mitigated by good construction practices, dust and runoff controls, and scheduling.	Future use of the capped areas would be prohibited.
3.	Excavate all unsaturated soils (108,000 cubic yards) in Areas I and II and one foot in a portion of Area VIII, with disposal in new 11-acre, double-lined, RCRA on-site landfill. Multimedia cap over landfill (Area I), Area II, and a portion of Area V (see Example Alternative 2). Controlled stormwater discharged from capped areas into Mill Creek	$18.3 Average annual O&M cost: $1.69	$31.9	Would eliminate direct human and animal contact with contaminated soils in capped areas and in Area VIII. Ability to achieve drinking water standards, ADI's, and SNARL's for organic and inorganic (metal) contaminants in groundwater beneath the site would be essentially identical to Example Alternative 2.	Would be identical to Example Alternative 2.	Would eliminate discharge of contaminated groundwater from Western Processing to Mill Creek while the pumping system is operating. Like Example Alternative 2, an extremely long post-construction pumping, treatment, and site maintenance period would be required before water quality standards, criteria, or background levels could be met in Mill Creek after the pumping system is turned off. Would require the same type of access as in Example Alternative 2.	Would comply with RCRA technical standards for construction and closure of a new hazardous waste landfill. Materials to be excavated have not yet been classified under the WDOE Dangerous Waste Regulations. No "Extremely Hazardous Waste" may be landfilled within Washington State. Certain excavated materials such as PCBs, buried drums, and concentrated wastes would require special handing and possibly disposal procedures. Future use of the landfill and capped areas would be prohibited.

Table S-9
(continued)

Example Alternative	Cost (Millions) Capital	Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
3. Continued Groundwater pumping around landfill and in portions of Areas II and V, onsite treatment, and discharge into Metro system (85 gpm) Monitoring Health and safety plans and training prior to construction.					Landfill liners and leachate collection system, when combined with the cap, would provide more protection from contaminant leaching from unsaturated zone into the groundwater than Example Alternative 2. Effective landfill and cap lifetime in this application is not known. The landfill would be constructed in phases, with the excavated material stored onsite. This would be very difficult, but not impossible, to accomplish on the limited (11-acre) space on Area I. Would require 48-month construction period. Cap and landfill would require relatively complex construction techniques. The landfill and cap combination would isolate approximately 60 percent of both the zinc and total contamination in the soil. Construction impacts could be mitigated by good construction practices, dust and run-off controls, and scheduling.	
4. The PRP Proposal[1] Excavate to variable depths (1' to 8') in Area I	$45.4 Average annual O&M cost: $1.9	$48.9	Would eliminate direct human and animal contact with all surface soils in Area I. ADI's, drinking water standards, and SNARL's for all except one indicator organic	Both during and after up to 5 years of pumping, Mill Creek water quality should be able to meet ambient water quality or background levels for all Western Processing-related contaminants. Water quality	Once the diversion barrier is installed, the discharge of contaminated groundwater to Mill Creek from Area I would be reduced by approximately 50 percent.	Does not address off-property contamination other than off-property contaminated groundwater (which could potentially be removed during the pumping program). Off-property remedial actions such as those

[1]Summary prepared by PRPs.

Table S-9
(continued)

Example Alternative	Cost (Millions) Capital	Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
4. Continued						
Offsite disposal of all excavated material (75,000 cubic yards) in a double-lined RCRA landfill Replace excavated material with imported fill Diversion wall, 40 feet deep, inside the perimeter of Area I Groundwater pumping and stormwater infiltration in Area I for up to 5 years, onsite or offsite treatment, discharge to Metro or the Green River (100 gpm) Asphalt pavement over Area I upon completion of pumping Monitoring Health and safety plans and training prior to construction			would be met within up to 5 years of pumping. Drinking water standards for metals could not be met even if the pumping program were extended indefinitely.	problems in the creek not related to Western Processing would continue.	Once pumping starts, the discharge of all contaminated groundwater from Area I would be prevented. The potential for discharge of contaminated stormwater runoff from Area I would be eliminated. The infiltration system that would operate during the pumping program would provide additional contaminant removal from the Area I unsaturated zone. Would require 24-month construction period. Installation of diversion barrier would require relatively complex construction techniques. Construction impacts could be mitigated by good construction practices, dust and runoff controls, and scheduling. Would remove 70 percent of contaminants from the unsaturated zone including 88 percent of the zinc contamination in Area I.	described in the other example alternatives would be one of the subjects of negotiations. The groundwater extraction rate for this alternative is primarily limited by considerations related to reducing total groundwater treatment requirements and secondarily by soil conditions. Double-lined landfill capacity is not cur[illegible]ailable in the Northwes[illegible] be available by [illegible] disposal costs were [illegible]ated to be $100 per ton, but could vary substantially. Property would be suitable for future use.
5. Excavate 15 feet in Areas I and II, 3 feet in a portion of Area V (including the old discharge line), 3 feet in Area IX, and 1 foot in a portion of Area VIII. Offsite disposal of all excavated material (300,000 cubic yards) in a double-lined RCRA landfill	$180.3 Average annual O&M Cost: $0.1	$164.0	Would eliminate direct human and animal contact with all surface soils contaminated by Western Processing. Would reduce concentrations of organic contaminants in the groundwater beneath Areas I and II to or near drinking water standards, ADI's, and SNARL's for longer term use. Lead levels will be reduced	Excavation would be sufficient to allow the levels of metals in Mill Creek, including zinc, to permanently meet ambient water quality criteria or background, whichever is higher. Would eliminate contaminated stormwater discharge to groundwater and Mill Creek.	Most reliable and proven source control alternative. Approximately 95 percent of all contamination in soil would be removed by excavation. Would permanently eliminate contaminated groundwater discharges to Mill Creek from Areas I and II. The off-property excavations would reduce most average metal concentrations in soils to background.	Complies with RCRA technical requirements for closure as a storage facility. Future property use would not be restricted. Double-lined RCRA landfill capacity is not currently available in the Northwest but will be available by mid-1985. The disposal costs were estimated to be $100 per ton but could vary substantially.

Table S-9
(continued)

	Example Alternative	Cost (Millions) Capital	Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
5.	Continued						
	Replace excavated material with imported soil Groundwater pumping for excavation, dewatering, onsite treatment, and discharge to the Metro system. Monitoring Health and safety plans and training prior to construction.			sufficiently to meet the drinking water standard; however, cadmium will not.	Water quality problems in Mill Creek not related to Western Processing would continue to limit habitat quality.	20 months of excavation over a 4-year construction period. Dewatering and groundwater treatment would continue during months when excavation is not occurring. 40,000 truck trips would be required to haul contaminated material away from and imported material to the site. Would require no operation or maintenance activities other than monitoring. No permanent access would be required. Construction impacts could be mitigated by good construction practices, dust and run-off controls, transportation plans, and scheduling.	
6.	Mill Creek No Action (After implementation of Example Alternative 2, 3, 4, or 5)	-0-	-0-	None. Mill Creek sediments do not pose a threat to human health.	The Mill Creek sediments, which are contaminated particularly with metals as a result of surface and groundwater discharges from Western Processing, would continue to be moved downstream (and eventually dispersed and diluted) by natural processes. Contaminants on sediments could adversely affect aquatic organisms by leaching into the water or by toxic effects on bottom dwelling organisms. Avoids the adverse impacts of diversion and excavation.	With an effective source control action (such as Example Alternative 2, 3, 4, or 5), it would take from 5 to 10 years for the contaminated sediments to be transported out of the local stream reach. The source control would have to remain effective for the sediments to remain uncontaminated.	Modification of Mill Creek above Western Processing as part of Kent's drainage master plan could change the effectiveness of this example alternative, as could the introduction of upstream sources of contaminants.
.	Mill Creek Sediment Removal (after implementation of Example Alternative 2, 3, 4, or 5)	$1.3		None. Mill Creek sediments do not pose a threat to human health.	All contaminated sediment in a 2,300-foot reach of Mill Creek would be removed.	Monitoring of groundwater quality and flow near the creek would be necessary to determine the optimal time to	Modification of Mill Creek above Western Processing as part of Kent's drainage master plan could change the

Table S-9
(continued)

Example Alternative	Cost (Millions) Capital	Cost (Millions) Present Worth	Public Health Aspects	Environmental Aspects	Technical Aspects	Other
7. Continued						
Excavate and dispose of sediment from the bed and banks of Mill Creek adjacent to and 1,300 feet downstream of Western Processing. (1,700 cubic yards)				Resuspension and downstream transport of contaminated sediments during construction would be prevented by diverting the creek around the reach to be excavated.	remove the contaminated sediments. The source control would have to remain effective for the sediments to remain uncontaminated.	effectiveness of this example alternative, as could the introduction of upstream sources of contaminants.
Divert 2,300 feet of Mill Creek into a pump-and-pipe system during excavation (approximately one month during low flow season)				Excavation and diversion would temporarily destroy 2,300 feet of aquatic habitat. Fish would not be able to pass through this part of Mill Creek during the one-month diversion.	One-month construction period. No operation and maintenance would be required.	
Rehabilitate stream bed with gravel riffles and natural vegetation				After streambed excavation and rehabilitation, water quality problems upstream of Western Processing, such as low dissolved oxygen levels, could continue to limit habitat quality in Mill Creek.		
Monitoring						

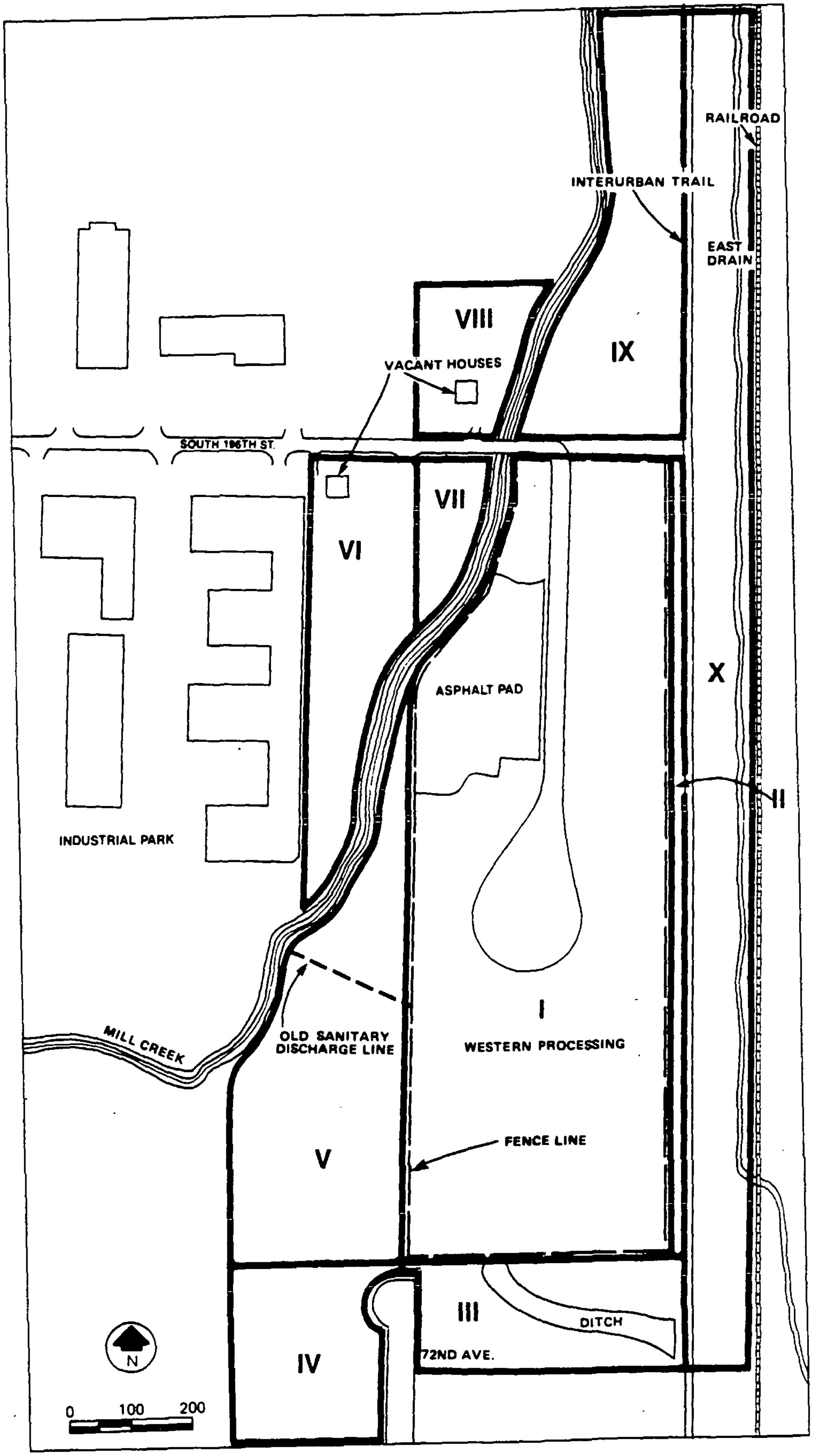

FIGURE S-16
ANALYSIS AREAS